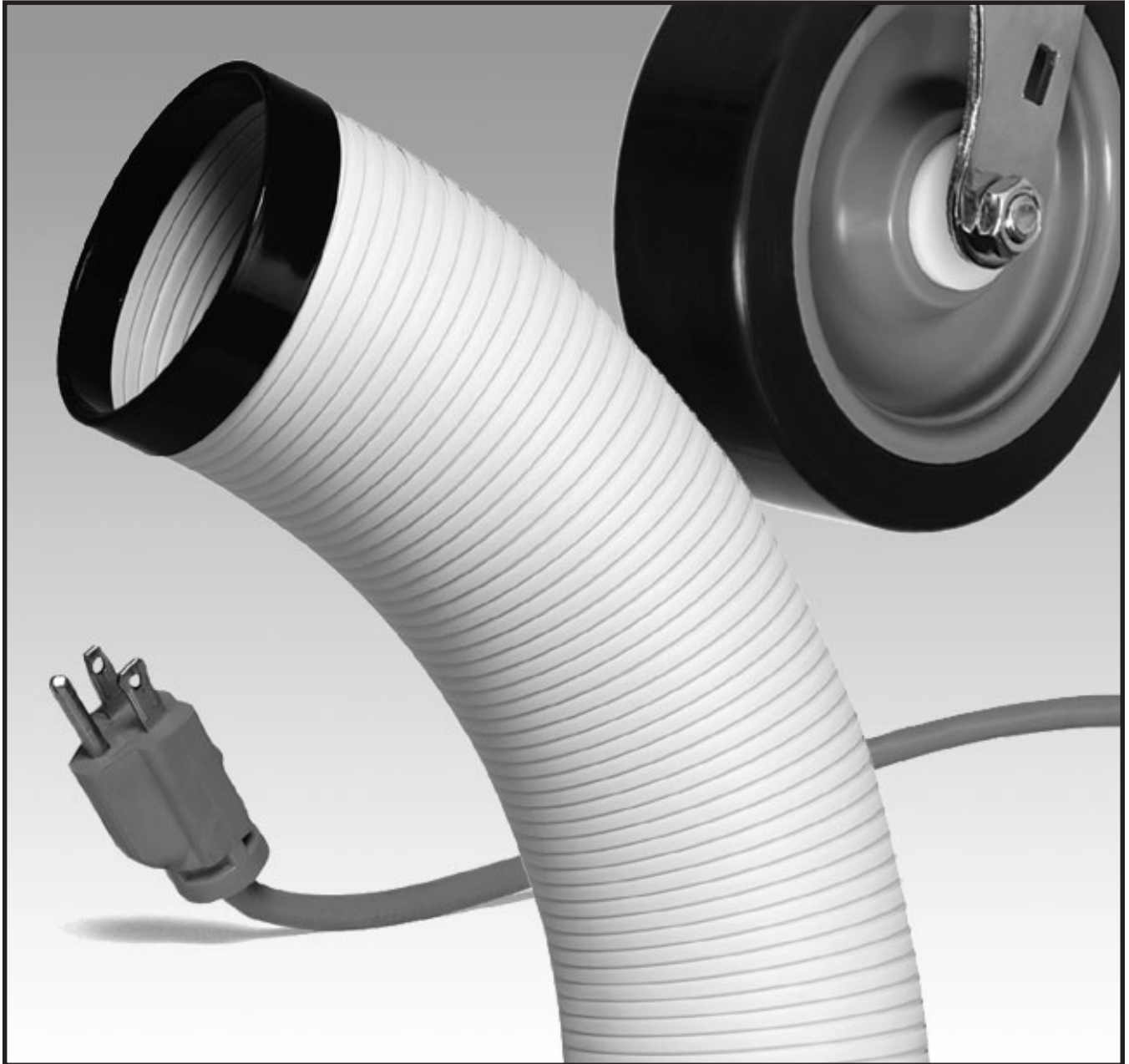


SERVICE **MANUAL**

OFFICE PRO 60



DENSO SALES CALIFORNIA, INC.
REGISTERED TO ISO 9002
FILE NO. A5537

MOVINCOOL®
THE PORTABLE SPOT COOLING SOLUTION

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SERVICE **MANUAL**

OFFICE PRO 60

MOVINCOOL®
THE PORTABLE SPOT COOLING SOLUTION

FOREWORD

This manual has been published to service the MovinCool Office Pro 60. Please use this service manual only when servicing the Office Pro 60.

DEFINITION OF TERMS

⚠WARNING: Describes precautions that should be observed in order to prevent injury to the user during installation or unit operation.

⚠CAUTION: Describes precautions that should be observed in order to prevent damage to the unit or its components, which may occur during installation or unit operation if sufficient care is not taken.

NOTE: Provides additional information that facilitates installation or unit operation.

GENERAL PRECAUTIONS

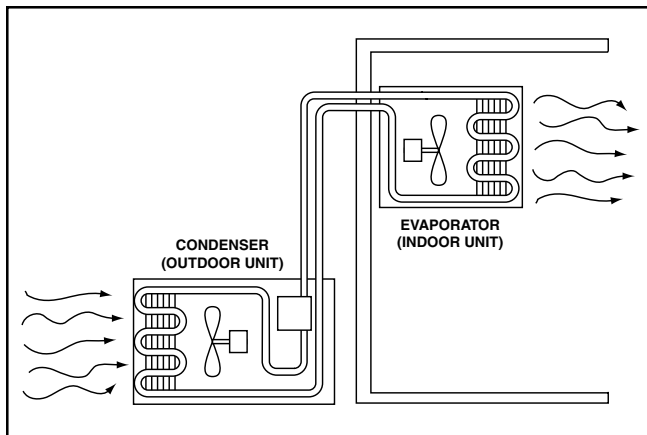
⚠WARNINGS:

- All electrical work if necessary, should only be performed by qualified electrical personnel. Repair to electrical components by non-certified technicians may result in personal injury and/or damage to the unit. All electrical components replaced must be genuine MovinCool, purchased from an authorized reseller.
- When handling refrigerant, always wear proper eye protection and do not allow the refrigerant to come in contact with your skin.
- Do not expose refrigerant to an open flame.
- The proper electrical outlet for MovinCool units must be equipped with a “UL” approved ground-fault breaker to prevent electrical shock from the unit.
- When brazing any tubing, always wear eye protection and work only in a well ventilated area.
- Disconnect power before servicing unit.
- Be careful of any sharp edges when working on unit.

TABLE OF CONTENTS

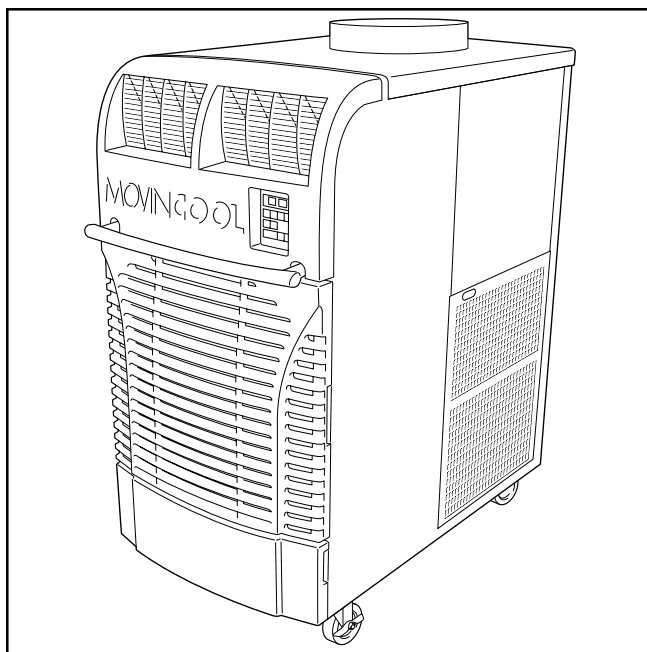
FOREWORD	i
DEFINITION OF TERMS	i
GENERAL PRECAUTIONS	i
TABLE OF CONTENTS	iii
GENERAL DESCRIPTION	1
CONSTRUCTION, SPECIFICATIONS, & DATA	3
REFRIGERANT SYSTEM	9
ELECTRICAL SYSTEM	15
TROUBLESHOOTING & REPAIR	21

GENERAL DESCRIPTION



Conventional Air Conditioner

Generally speaking, conventional air conditioners cool the entire enclosed environment. They act as “heat exchangers”, requiring an interior unit (evaporator) to blow cool air into the interior and an exterior unit (condenser) to exhaust exchanged heat to the outdoors. Unlike conventional air conditioners, the MovinCool Spot Cooling System is a spot cooler which directs cool air to particular areas or objects. MovinCool Spot Cooling Systems have the following features:



Office Pro 60

1. Compact Design

The innovative design of MovinCool has resulted in one compact unit, replacing the need for two separate units.

2. Easy Transportation and Installation

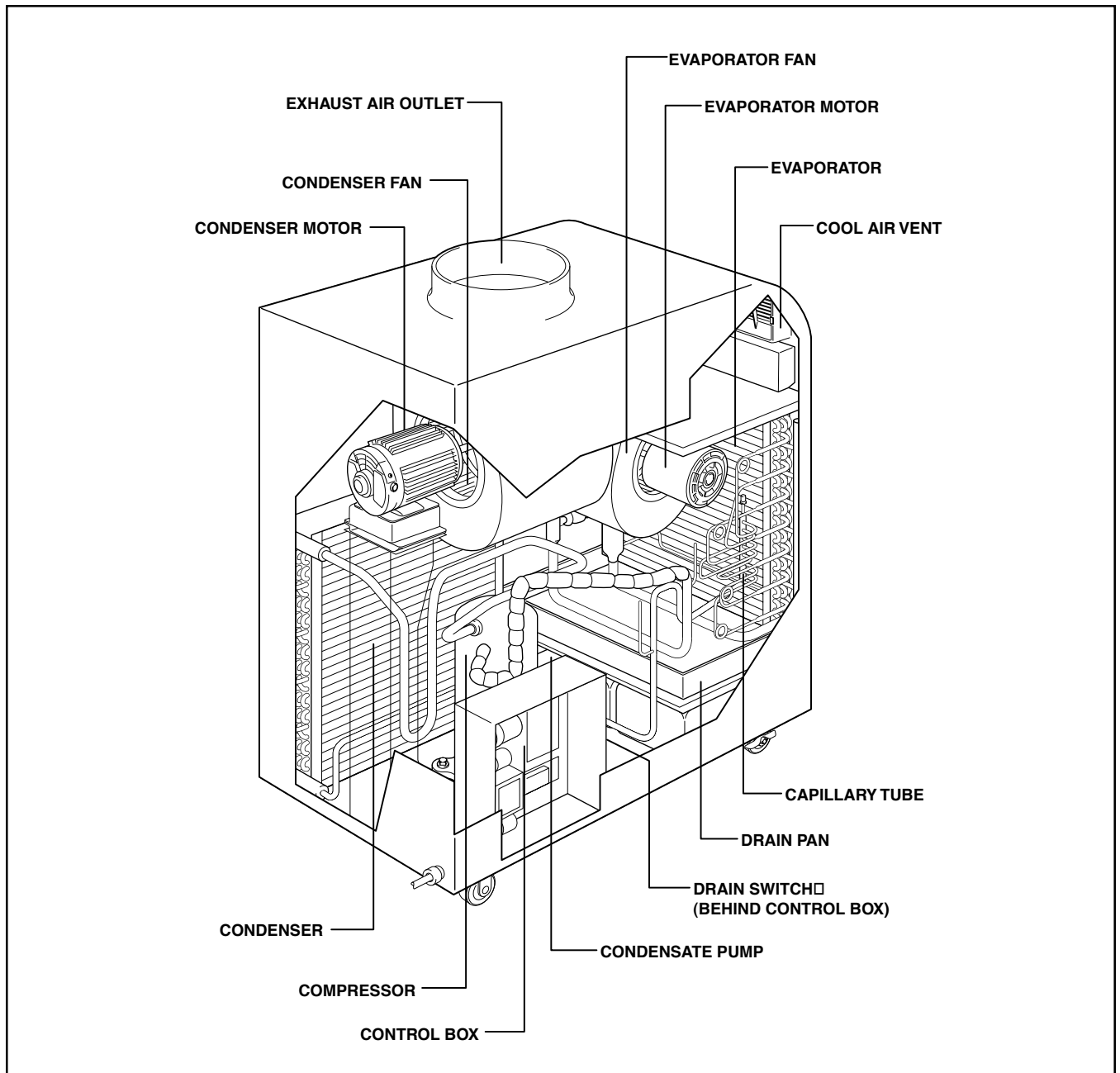
With the whole cooling system built into one compact unit, MovinCool requires no piping and can be easily transported and installed.

3. Energy Conservation

MovinCool is economical because it cools only the area or objects which need to be cooled.

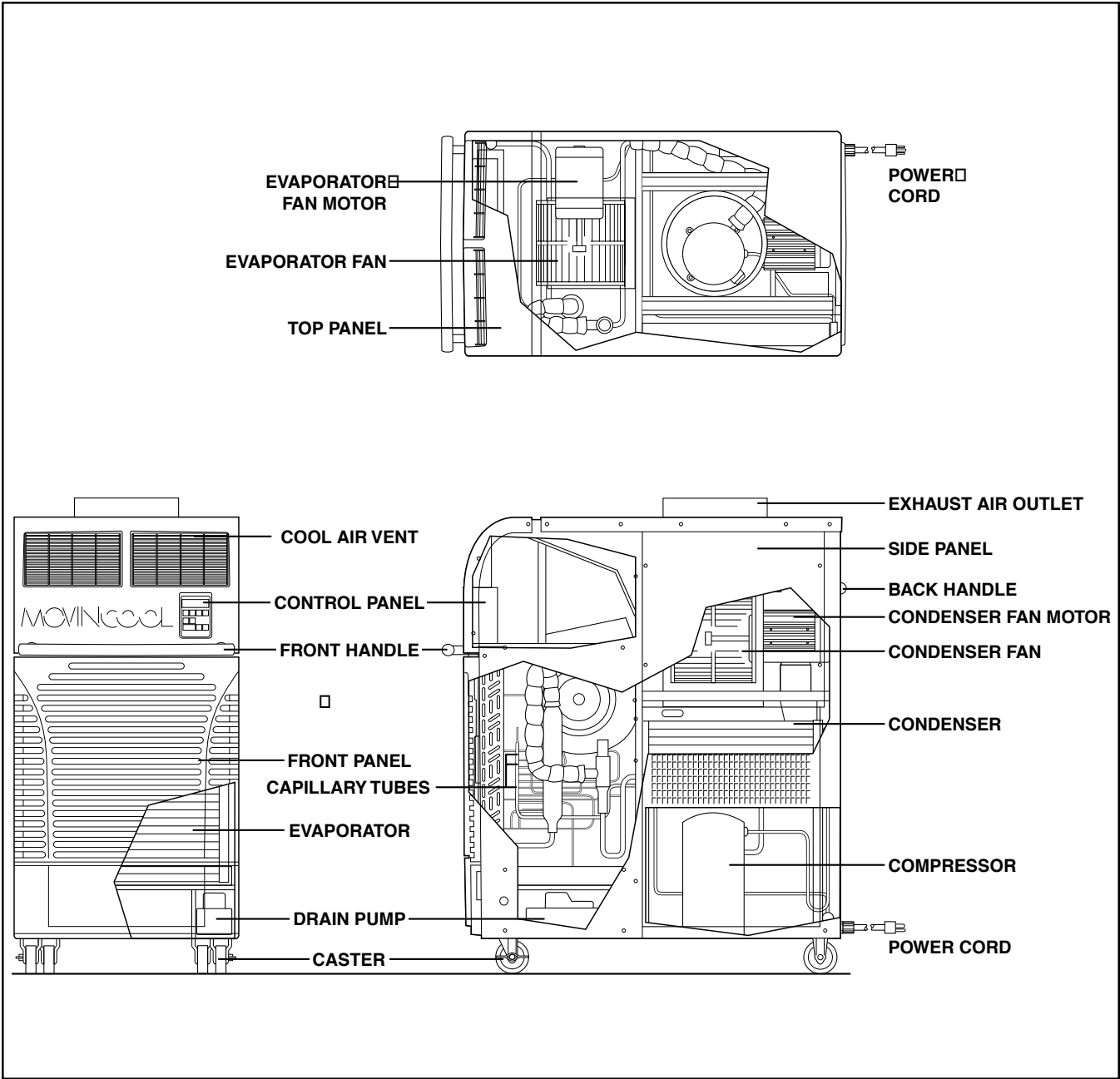
GENERAL DESCRIPTION

CONSTRUCTION, SPECIFICATIONS, and DATA



Construction of Office Pro 60

CONSTRUCTION, SPECIFICATIONS, and DATA



Construction Diagram

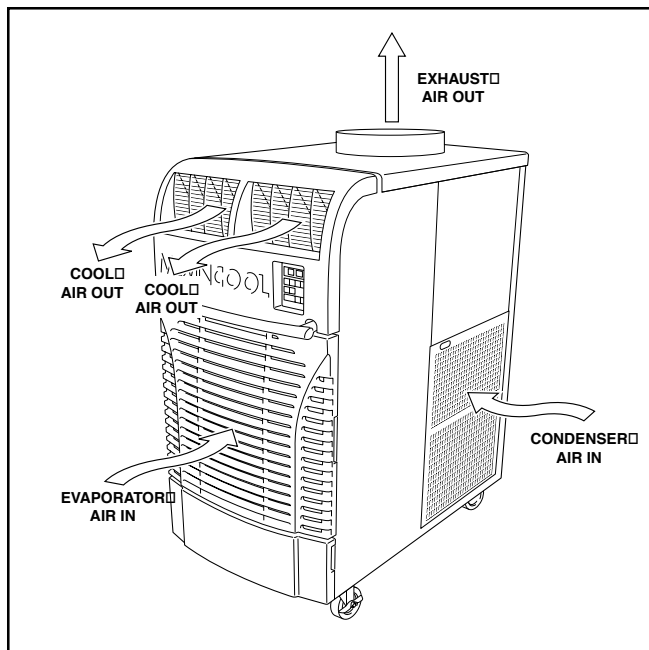
CONSTRUCTION, SPECIFICATIONS, and DATA

1. Basic Construction

The MovinCool Spot Cooling System is compact in construction because the condenser and the evaporator are enclosed in one unit. The interior is divided into three sections. The upper front face is equipped with the evaporator, while the lower front face contains the drain tank (optional). The rear section contains the condenser, the compressor and the control box.

2. Air Flow

Air drawn from the right side face passes through the condenser which extracts the heat. This hot air is blown out through the upper exhaust air duct. Air taken in from the front face is cooled by the evaporator and then blown through the cool air vent. All the air inlets are equipped with filters, while the exhaust air outlet is protected by wire mesh.



Air Flow

3. Compressor and Fans

The compressor is hermetically sealed. A two-speed fan motor is used with two centrifugal fans to draw air across the evaporator and condenser.

4. Drain Tank (Optional)

The capacity of the drain tank is 5.0 gallons (19 liters). The unit is equipped with a “Tank Full” LED and a device to automatically stop the operation of the unit when the drain tank reaches a level of approximately 4.0 gallons (15 liters).

5. Condensate Pump

The condensate pump will pump water from the pump's main tank to a nearby sink or floor drain. The pump will lift the water a vertical distance of 18 feet. A plastic hose is supplied with the pump. The condensate pump is included with the Office Pro 60. It is important that the drain line from the pump is not kinked or bent.

CONSTRUCTION, SPECIFICATIONS, and DATA

Rating Conditions

dry bulb	95° F (35° C)
wet bulb	83° F (28.2° C)
humidity	(60%)

Specifications

power frequency	60Hz
line voltage	single phase 208/230V
power consumption	7.1 Kw
current consumption	33 Amps
power factor	94%
starting current	140A
power wiring	6 (3-core) AWG

Power Requirements

transformer size	20 KVA
------------------------	--------

Cooling Unit

cooling capability	15,100 Kcal/hr 60,000 BTU/hr
cooling system	direct expansion

Blower

type of fan	centrifugal fan
air volume:	Evaporator (High speed) 1940 ft ³ /min (3296 m ³ /h)
	Evaporator (Lo speed) 1770 ft ³ /min (3007 m ³ /h)
	Condenser (High speed) 2830 ft ³ /min (4804 m ³ /h)
	Condenser (Lo speed) 2650 ft ³ /min (4502 m ³ /h)
motor output:	Condenser (High) 1.12 Kw
	Condenser (Low) 0.93 Kw
	Evaporator (High) 0.50 Kw
	Evaporator (Low) 0.33 Kw

Compressor

type	Hermetic scroll
output	4.7 Kw
refrigerant type	R-22
refrigerant capacity	6.83 lbs (3.1 kg)

Safety Devices

compressor overload protector	included
fan motor protector	included
anti-freezing thermistor	included
full drain tank switch	included
automatic restart (power interruption)	included
compressor time delay program	included

Dimensions & Weight

W x D x H (in)	30" x 52" x 64.4"
W x D x H (mm)	760 x 1320 x 1635
weight (lbs/kg)	625 / 283

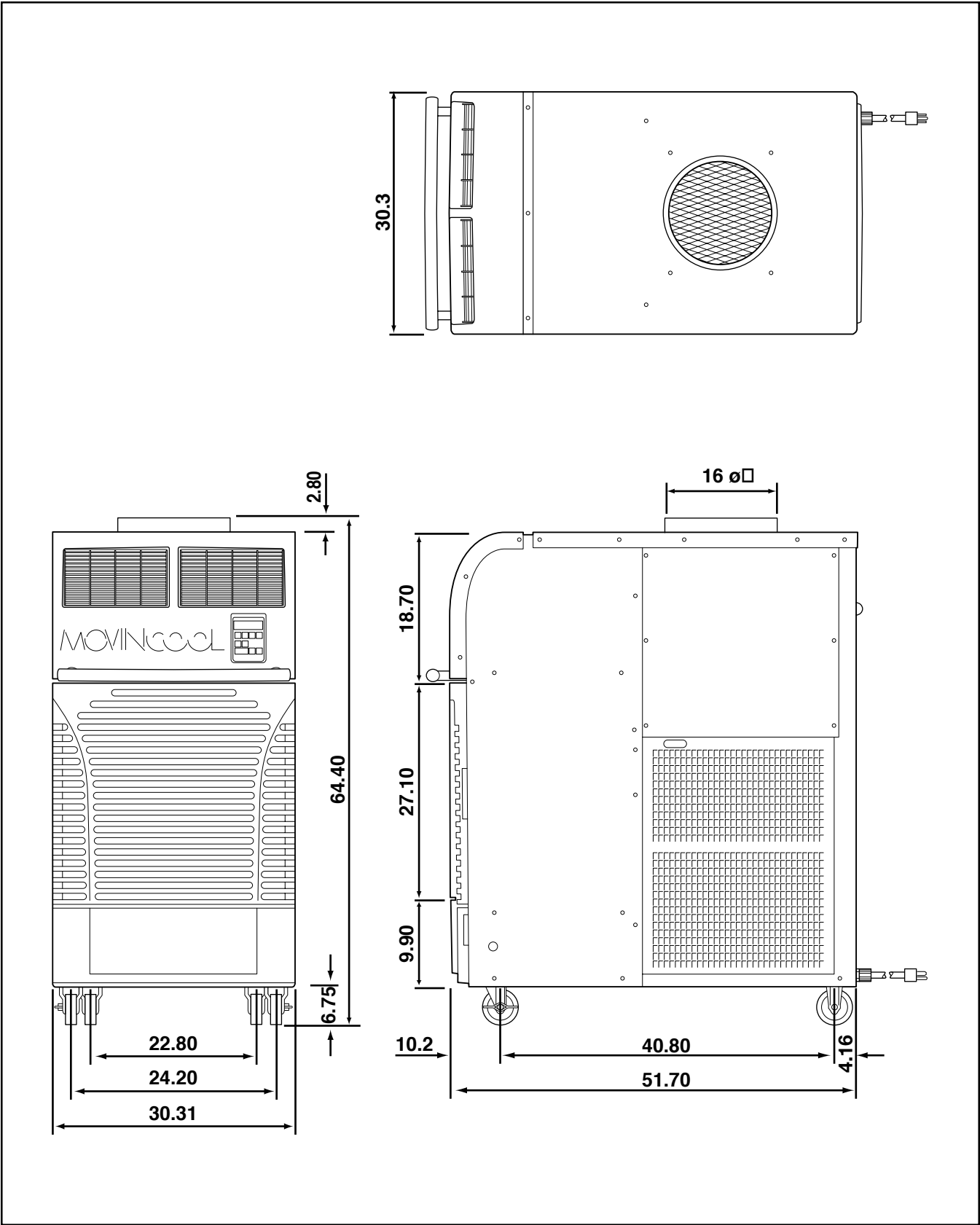
Operating Conditions

inlet air (relative humidity)	106° F (41° C) 65° F (18.3° C), (50%)
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Control Devices

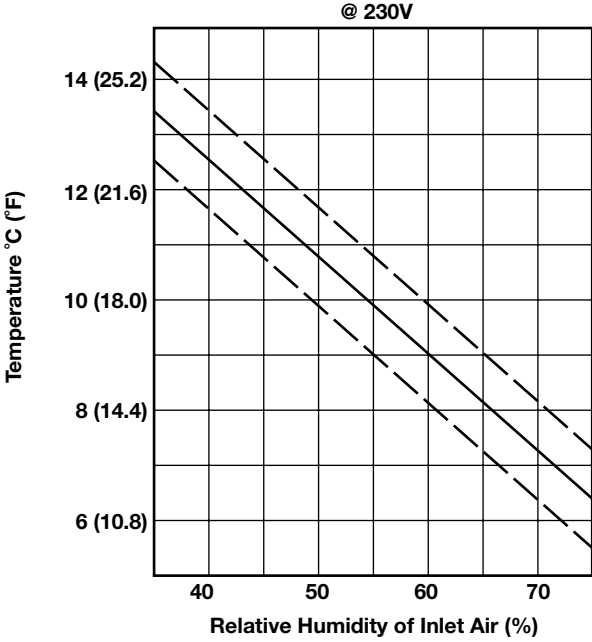
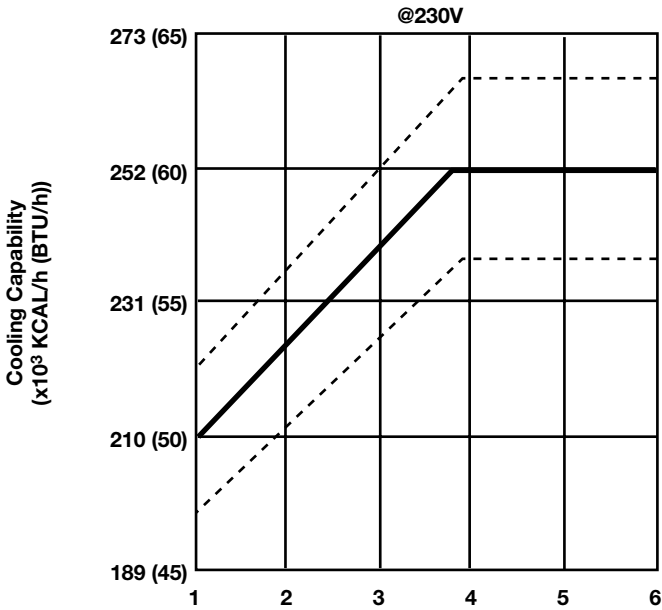
temperature control	included
programmable timer	included
two speed fan	included

CONSTRUCTION, SPECIFICATIONS, and DATA

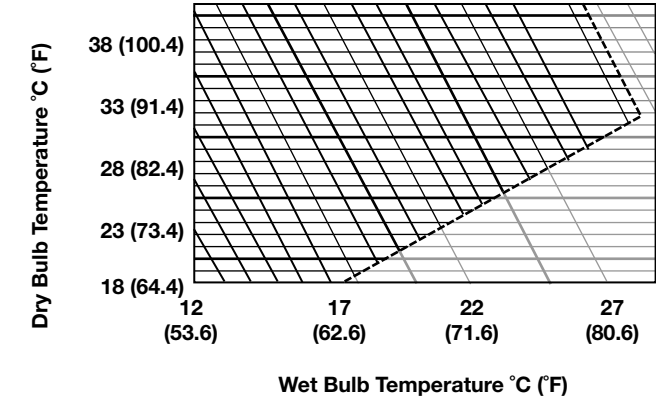


Exterior Dimensions (units: inches)

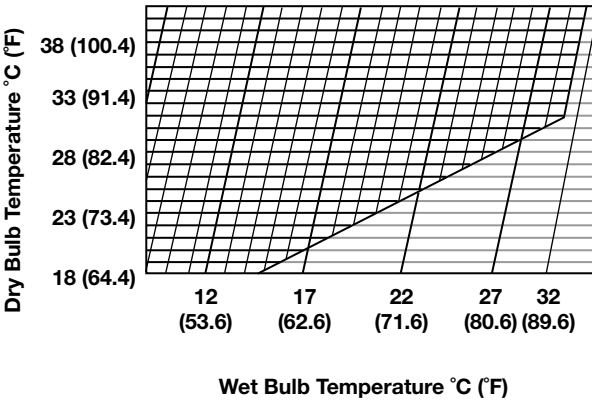
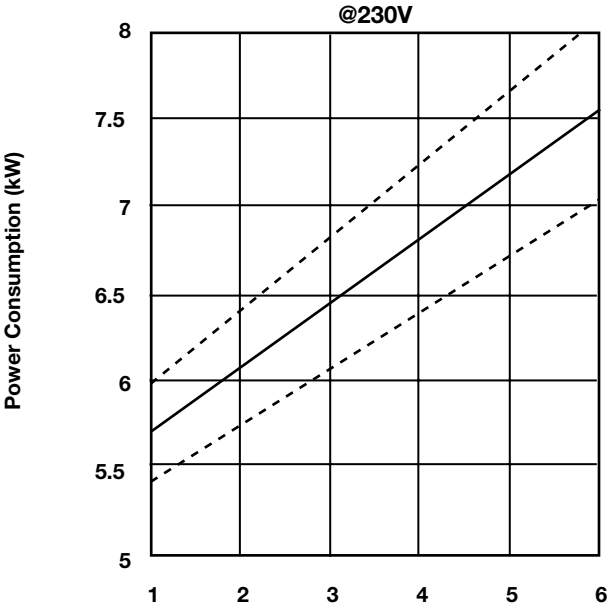
DATA



Cool Air Temperature Difference Curve



Cooling Capacity Curve



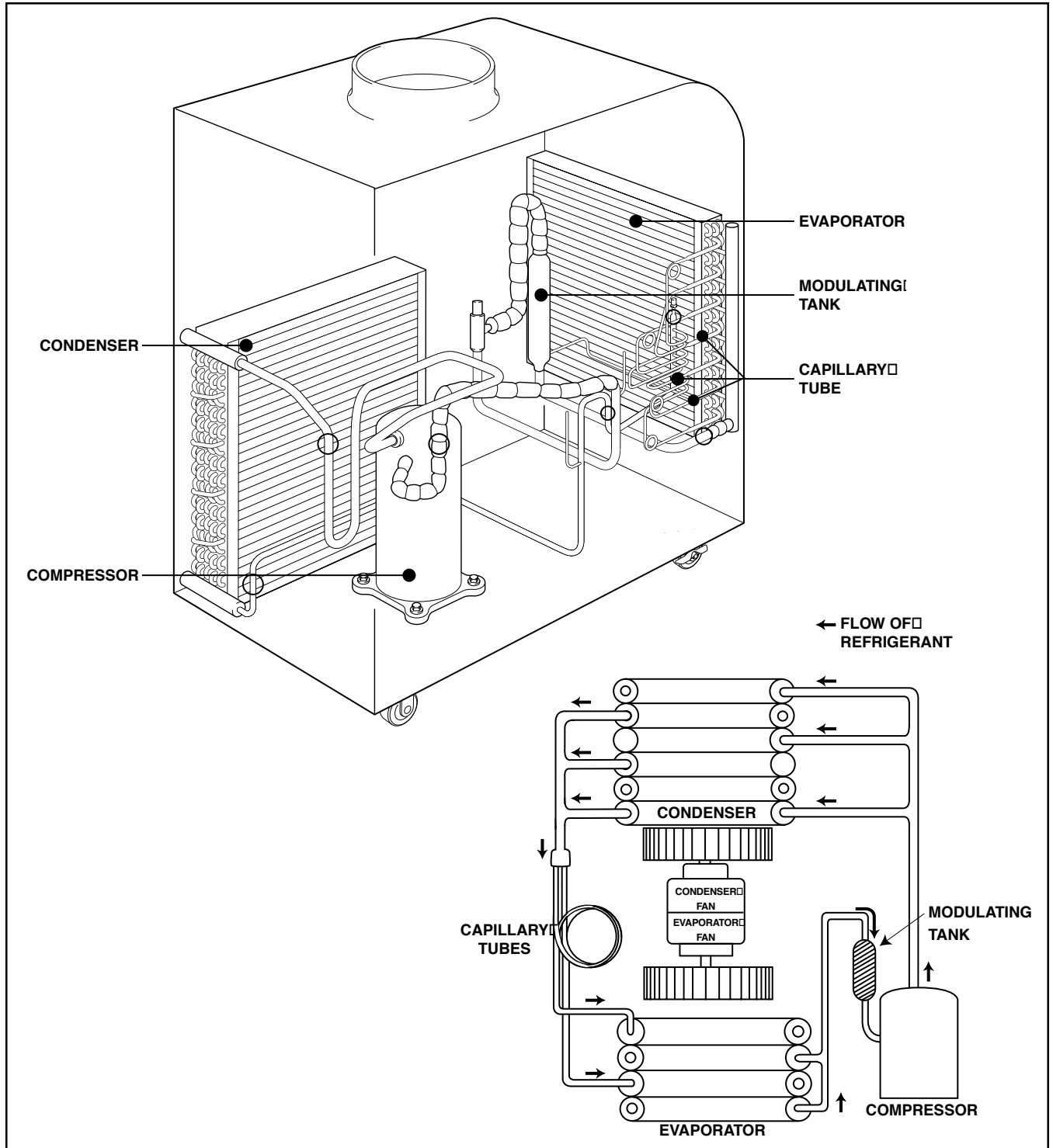
Power Consumption Curve

REFRIGERANT SYSTEM

1. The component parts of the refrigerant system include the following:

- Compressor
- Evaporator
- Condenser
- Modulating tank
- Capillary tube

These parts are all connected by copper tubing. All the connections have been brazed.



Refrigerant System

REFRIGERANT SYSTEM

1. Compressor

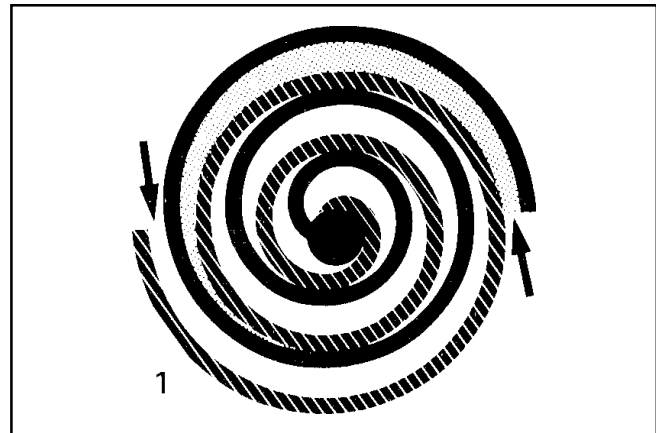
The compressor used for the unit is hermetically sealed. The compressor and the compressor motor are in one casing.

A. Compressor Theory of Operation

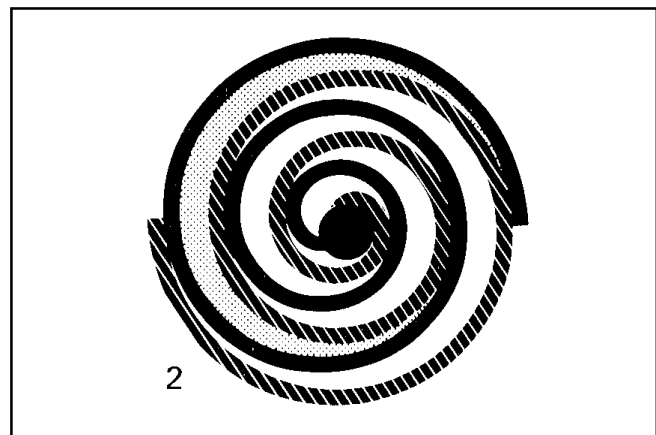
The scroll utilizes an involute spiral which, when matched with a mating scroll form, generates a series of crescent-shaped gas pockets between the two members. During compression, one scroll remains stationary (fixed scroll) while the other form (orbiting scroll) is allowed to orbit (but not rotate) around the first form. As this motion occurs, the pockets between the two forms are slowly pushed to the center of the two scrolls while simultaneously being reduced in volume. When the pocket reaches the center of the scroll form, the gas, which is now at a high pressure, is discharged out of a port located at the center. During compression, several pockets are being compressed simultaneously, resulting in a very smooth process. Both the suction process (outer portion of the scroll members) and the discharge process (inner portion) are continuous.

B. Compressor Operation

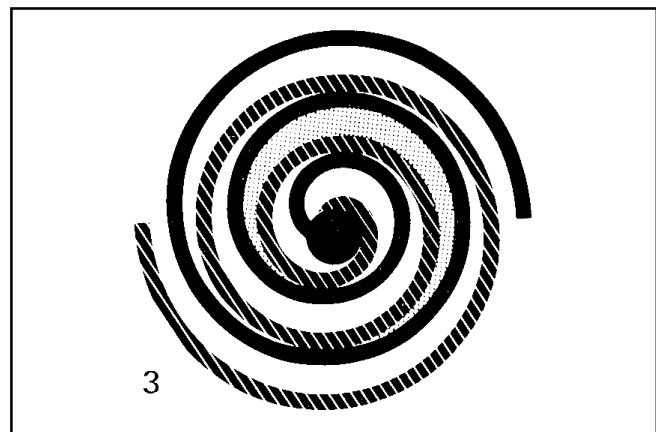
- 1) Compression in the scroll is created by the interaction of an orbiting spiral and a stationary spiral. Gas enters the outer openings as one of the spirals orbits.



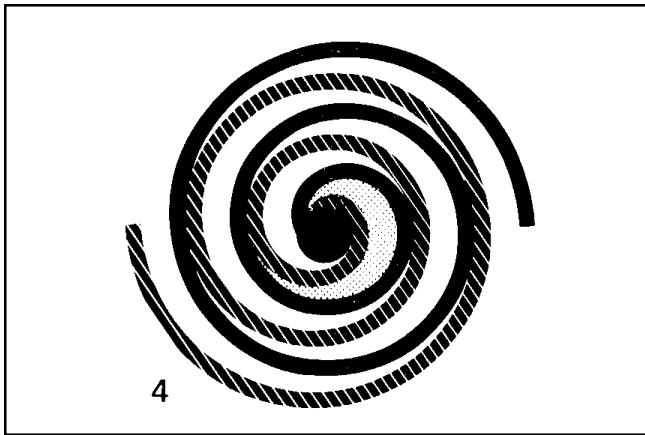
- 2) The open passages are sealed off as gas is drawn into the spiral.



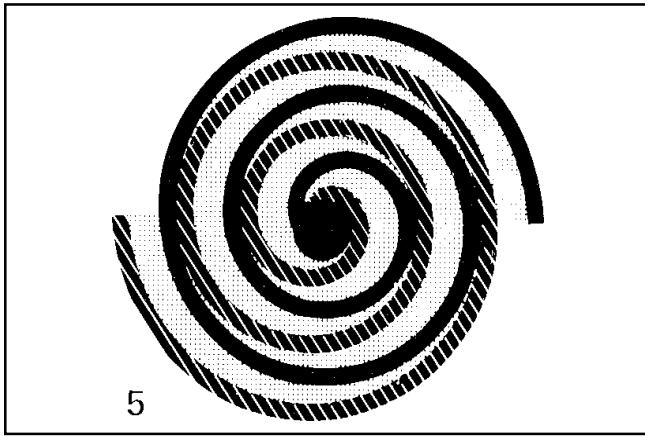
- 3) As the spiral continues to orbit, the gas is compressed into two increasingly smaller pockets.



REFRIGERANT SYSTEM



- 4) By the time the gas arrives at the center port, discharge pressure has been reached.



- 5) Actually, during operation, all six gas passages are in various stages of compression at all times, resulting in nearly continuous suction and discharge.

NOTE: Upon compressor shut-off, the compressor may run backward for a moment or two until internal pressures equalize. This has no effect on compressor durability but may cause an unexpected sound after the compressor is turned off and should not be diagnosed as a malfunction.

2. Condenser

The condenser is a heat exchanger utilizing plate fins. Heat is given off and absorbed by air being pulled across the condenser fins by the centrifugal fan and then expelled through the exhaust air outlet.

REFRIGERANT SYSTEM

3. Capillary Tubes

The capillary tubes are long thin tubes utilizing line flow resistance to serve as an expansion valve. The length and the inner diameter of the capillary tubes are determined by the capacity of the refrigeration system, specified operating conditions, and the amount of refrigerant.

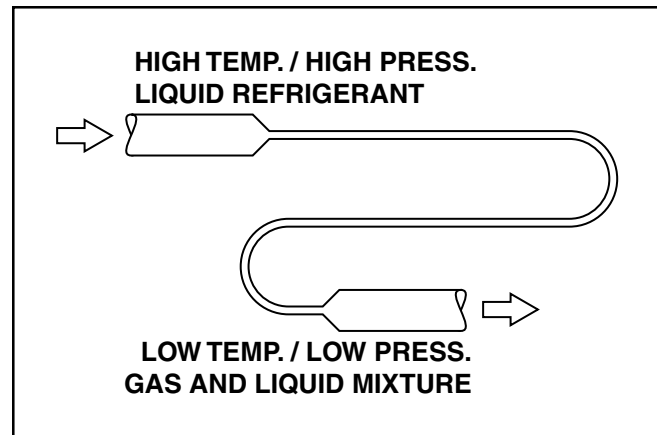
The capillary tubes cause the high pressure, high temperature liquid refrigerant sent from the condenser to expand rapidly as the refrigerant is sprayed out through the fixed orifice in the capillary tubes. As a result, the temperature and state of the refrigerant become low and mist-like respectively, causing it to evaporate easily.

4. Evaporator

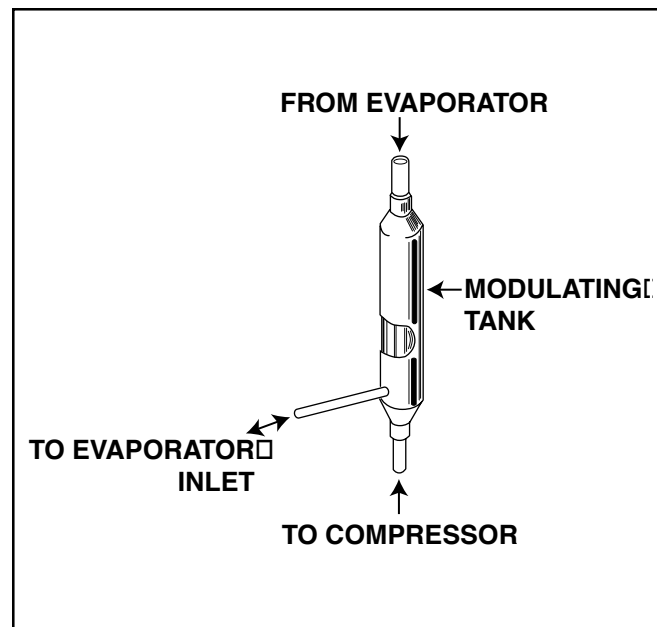
The evaporator, like the condenser, is a heat exchanger utilizing plate fins. Heat is removed from the air being pulled across the evaporator by the centrifugal fan and the resulting cool air is expelled through the cool air vent.

5. Modulating Tank

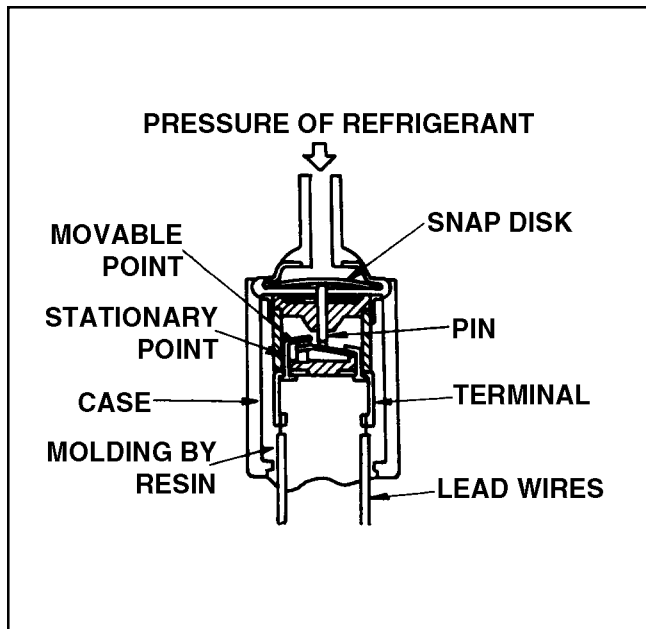
The modulating tank consists of a copper pipe and tank sections, each being separated from the other. The pipe connects to the evaporator outlet at one end and to the compressor at the other; the tank connects to the evaporator inlet. The modulating tank is covered with insulation to reduce thermal effects of ambient temperature. It varies the quantity of refrigerant in the refrigerating cycle for optimum operating condition; it stores part of refrigerant under light load and delivers additional refrigerant to the cycle under heavy load.



Capillary Tube



Modulating Tank



High Pressure Switch

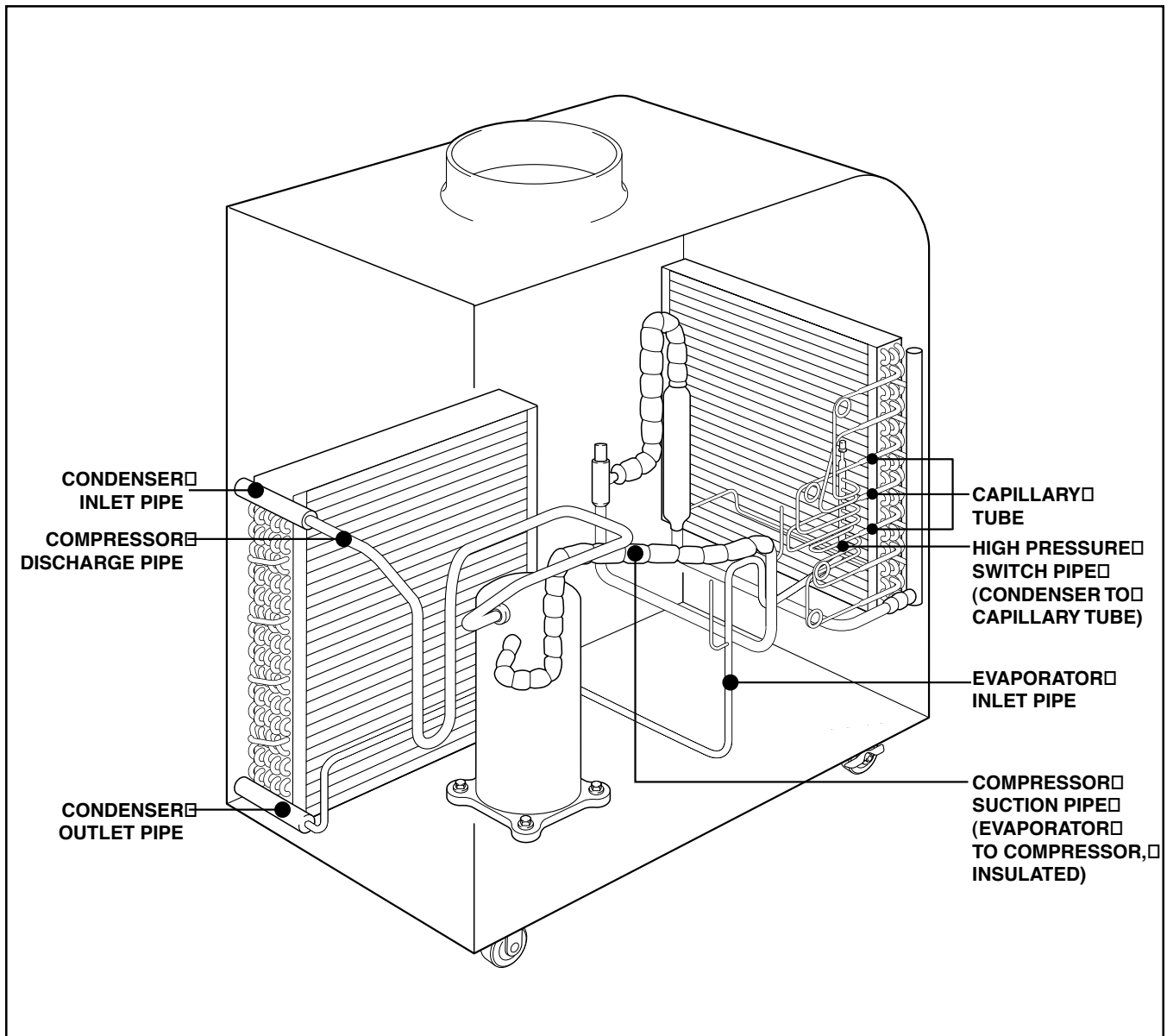
6. High Pressure Switch

The high pressure switch prevents the condenser and compressor from being damaged by excessively high pressure in the high pressure line of the refrigeration cycle. The switch is normally closed. The snap disk responds to variations in pressure and, if pressure is abnormally high, the snap disk moves down to push the pin down, causing the internal contacts to open. This interrupts the ground signal at the Control Board (J104) connector) which turns the compressor off.

Possible causes of this trouble include:

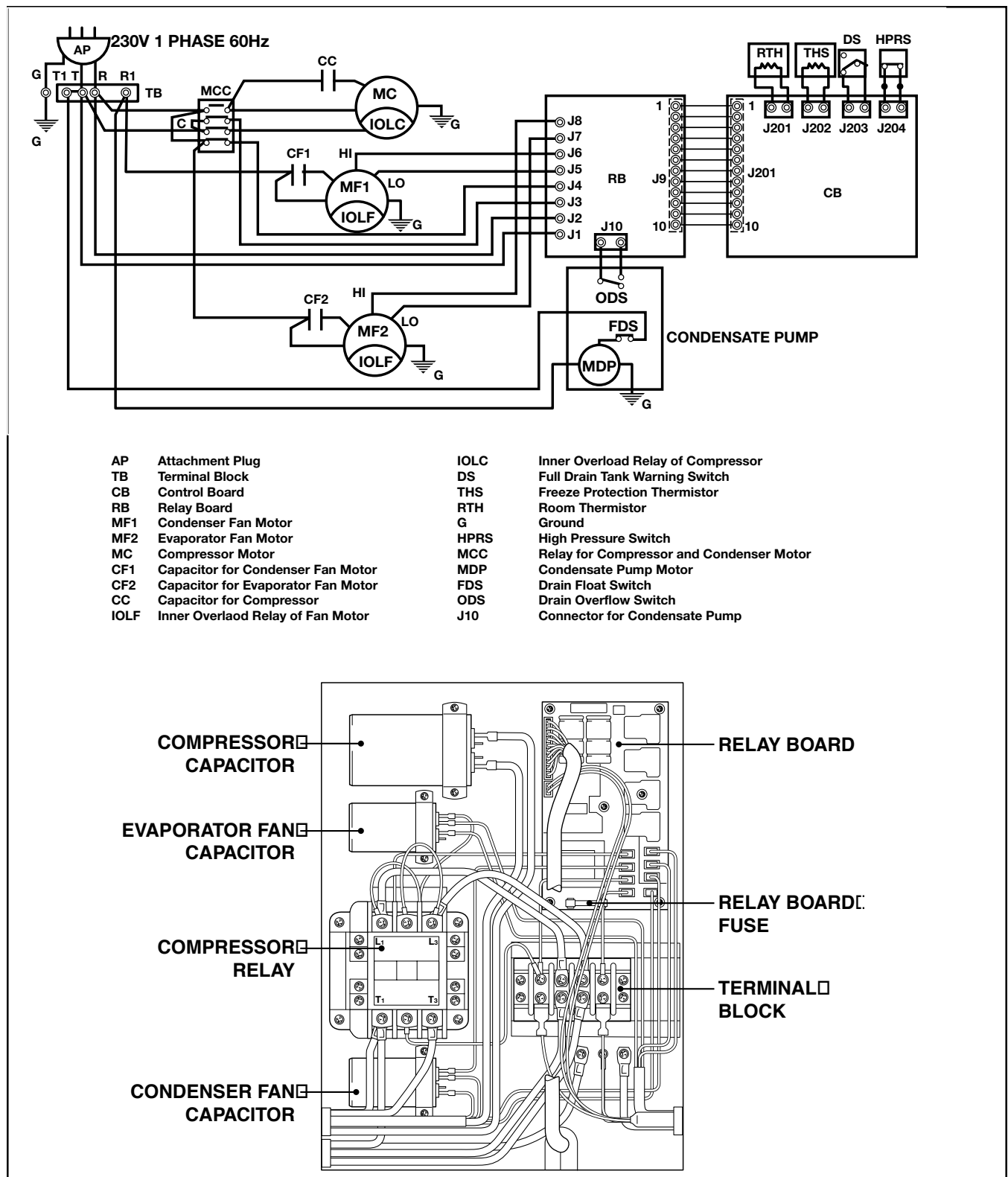
- A. The condenser air filter is dirty, restricting air flow.
- B. The condenser blower is defective.

REFRIGERANT SYSTEM



Refrigerant System Piping

ELECTRICAL SYSTEM



Electrical System and Control Box

ELECTRICAL SYSTEM

1. Basic Operation of Office Pro 60 Electrical Circuit

There are two basic components used to control the operation of the Office Pro 60 Electrical System:

- Control Panel Assembly
- Control Box

The Control Panel Assembly contains the Control Panel, Control Board (with inputs for the freeze and room temperature thermistors), drain switch, and a microprocessor.

A. Fan “Only” Mode (Evaporator)

Low Fan Mode - When the “Low” Fan Mode button on the control panel is pressed, the microprocessor turns on the button’s LED and activates the Fan “On” Relay (Relay Board), sending line voltage (208/230 VAC) to the N.C. (Normally Closed) contacts of the fan “mode” relay. This output is connected to the J7 terminal (relay board) where the LOW SPEED wire of the fan motor is connected.

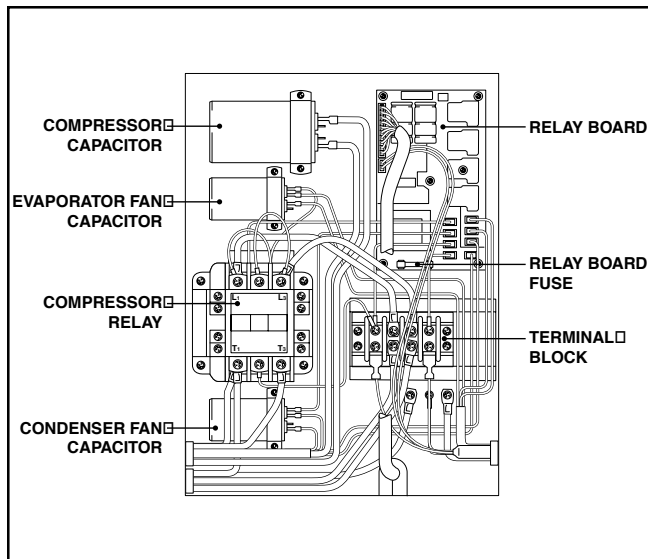
Note: Low fan mode does not operate in Fan “Only” mode.

High Fan Mode – When the “High” Fan Mode button on the control panel is pressed, the microprocessor turns on the button’s LED and activates both the Fan “On” Relay and Fan “Mode” Relay. This sends line voltage (208/230 VAC) from the Fan “On” Relay to the N.O. (Normally Open) contacts of the Fan “Mode” Relay. This output is connected to the J8 terminal (relay board) where the HIGH SPEED wire of the Fan Motor is connected.

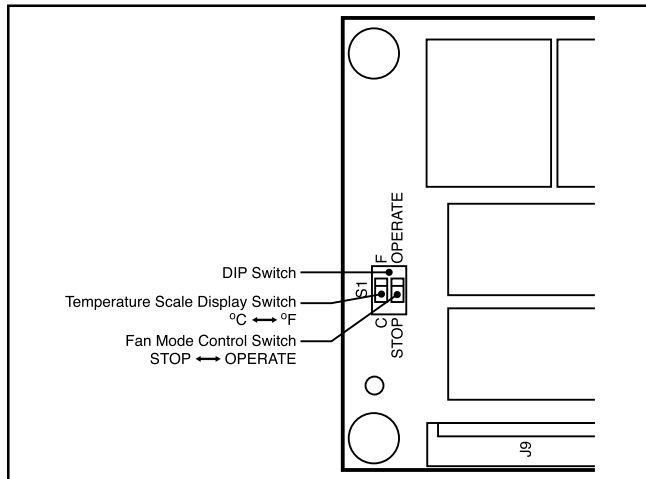
B. Cool Mode - In Addition to Fan “Only” Mode (as described above)

When the Cool On/Off button on the control panel is pressed, the microprocessor turns on the button’s LED and if the Temperature Set Point is less than the current room temperature, this activates the Compressor Relay (Relay Board) after a ninety second delay. This sends line voltage (208/230 VAC) to

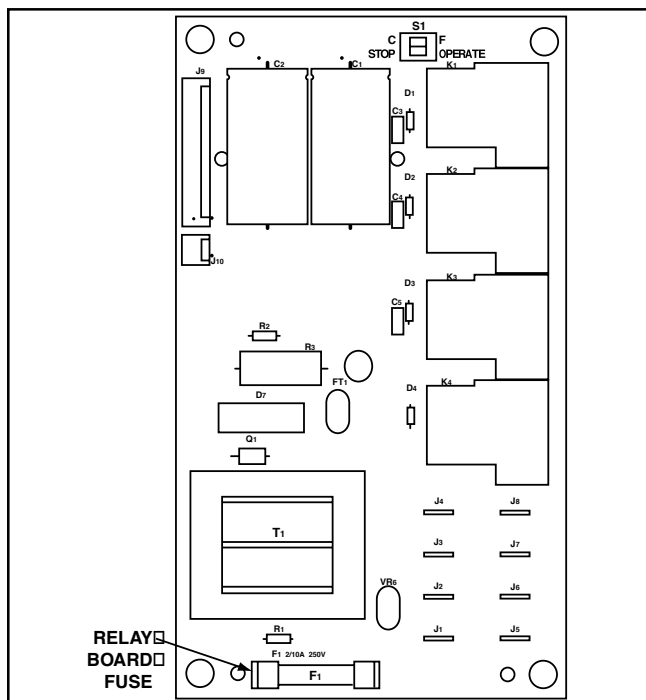
ELECTRICAL SYSTEM



Control Box



DIP Switch



Relay Board

the J4 terminal (Relay Board) where the wire from the Compressor wire harness is connected.

2. Control Box

A. Capacitors

The capacitors are used to temporarily boost the power output available to the fan motor and the compressor at start-up.

The specifications of each capacitor are listed below:		
CAPACITOR APPLICATION	VOLTAGE RATING	CAPACITANCE (μf)

Evaporator Fan Motor	440	15
Compressor	370	70
Condenser Fan Motor	370	25

B. Relay Board

The relay board receives signals and outputs from the control board that contains a micro-processor. The relay board contains the compressor, fan on and fan mode (speed) relays. It also contains a step-down transformer that converts the line voltage (230 VAC) to 12 volts. This is then converted from AC to DC and used for relay coil activation. The 12V (DC) power is sent to the Control Panel Assembly where it is further regulated to 5 volts for the system logic.

The relay board also contains the DIP-Switch. The DIP-Switch is used to change the Fan Mode operation from Stop to Operate and change the Set Point temperature display from °F to °C.

NOTE: The relay board must be serviced as a complete assembly. It has only one serviceable component, the fuse.

(a) Relay Board Fuse

NOTE: The relay board fuse is the only serviceable component on the relay board assembly.

This fuse provides protection against damage to the step-down transformer. It must be replaced with the exact type of fuse or an equivalent.

Fuse Specifications: 2/10A 250V

⚠CAUTION: Failure to use the exact type of fuse

ELECTRICAL SYSTEM

could result in damage to the unit and/or to components. It will also void the warranty of the unit.

3. Fan Motor (Evaporator)

The fan motor is a single phase, induction type two-speed motor.

Specifications: Rated Voltage: 230 Volts 60 Hz
Rated Output: (low) 326 watts
(high) 500 watts

4. Fan Motor (Condenser)

The condenser fan motor is a single phase induction type two-speed motor.

Specifications: Rated Voltage: 932 Volts 60Hz
Rated Output: (low) 932 watts
(high) 1195 watts

5. Compressor Motor

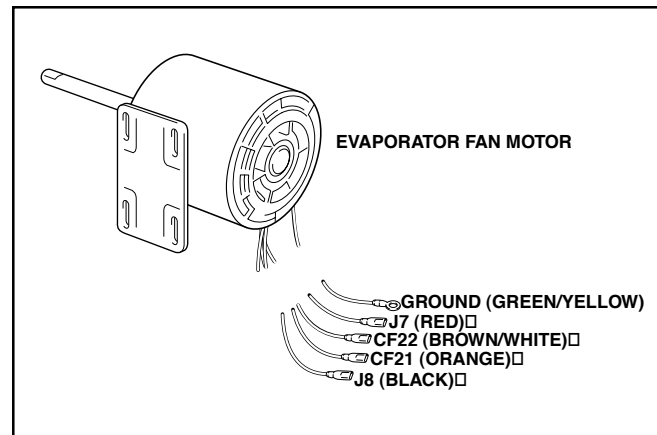
The compressor motor is a single phase motor. It is contained within the same housing as the compressor.

Specifications: Rated Voltage: 230 volts
Rated Output: 4700 Watts

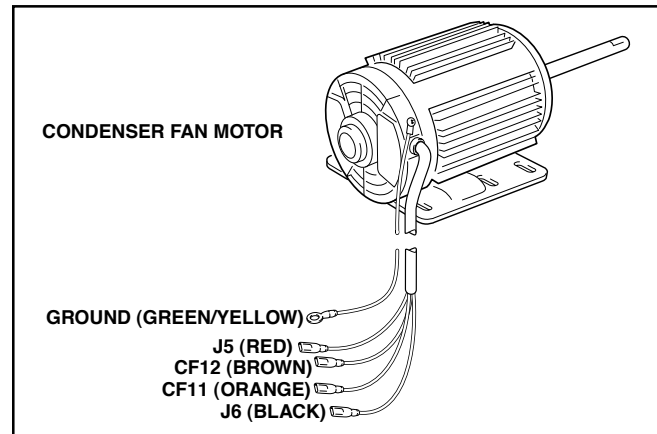
NOTE: An internal overload relay is used to protect the compressor motor and fan motor(s). This relay is built into the compressor motor and fan motor(s) and will interrupt the flow of current when there is an overcurrent situation or if abnormally high temperature builds up in the compressor motor or fan motor(s).

6. Condensate Pump

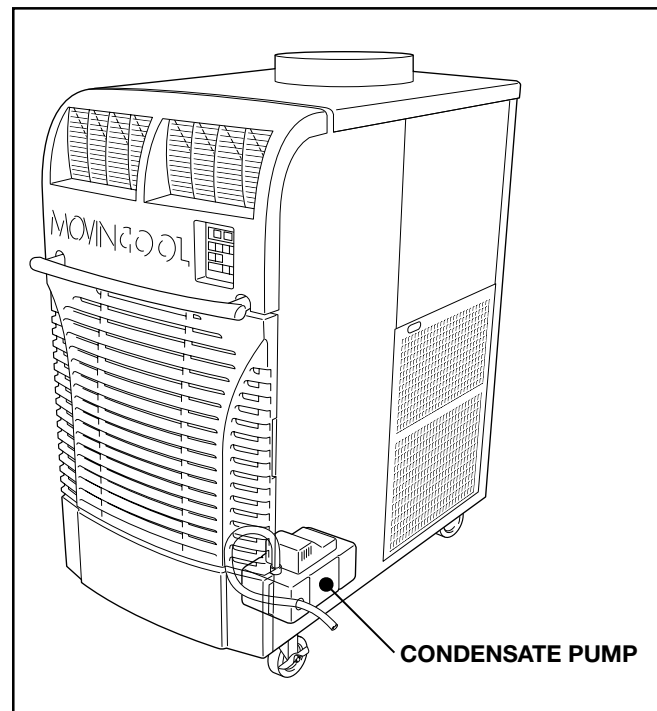
The Office Pro 60 model comes standard with a



Evaporator Fan Motor



Condenser Fan Motor



Condenser Fan Motor

ELECTRICAL SYSTEM

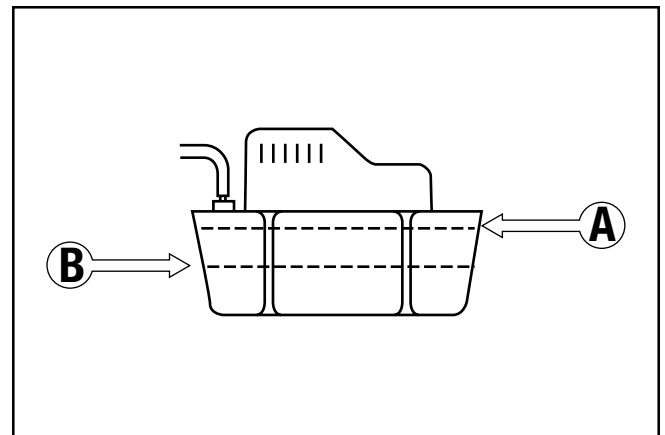
condensate pump, which collects the water that forms on the evaporator during normal cooling operation and eliminates the need for a drain tank.

When the water collects to level (A) in the pump reservoir, the drain pump begins to operate and discharges the water.

When the water level drops below level (B), the drain pump will stop.

NOTE:

- ***If for any reason the water level exceeds that of level (A) in the pump reservoir, an overflow Drain Switch will stop the compressor operation.***
- ***If the Fan Mode Control DIP Switch (see pg.17) has been set from the COOL to the STOP position, the Fan will also turn off while the drain pump is discharging water.***

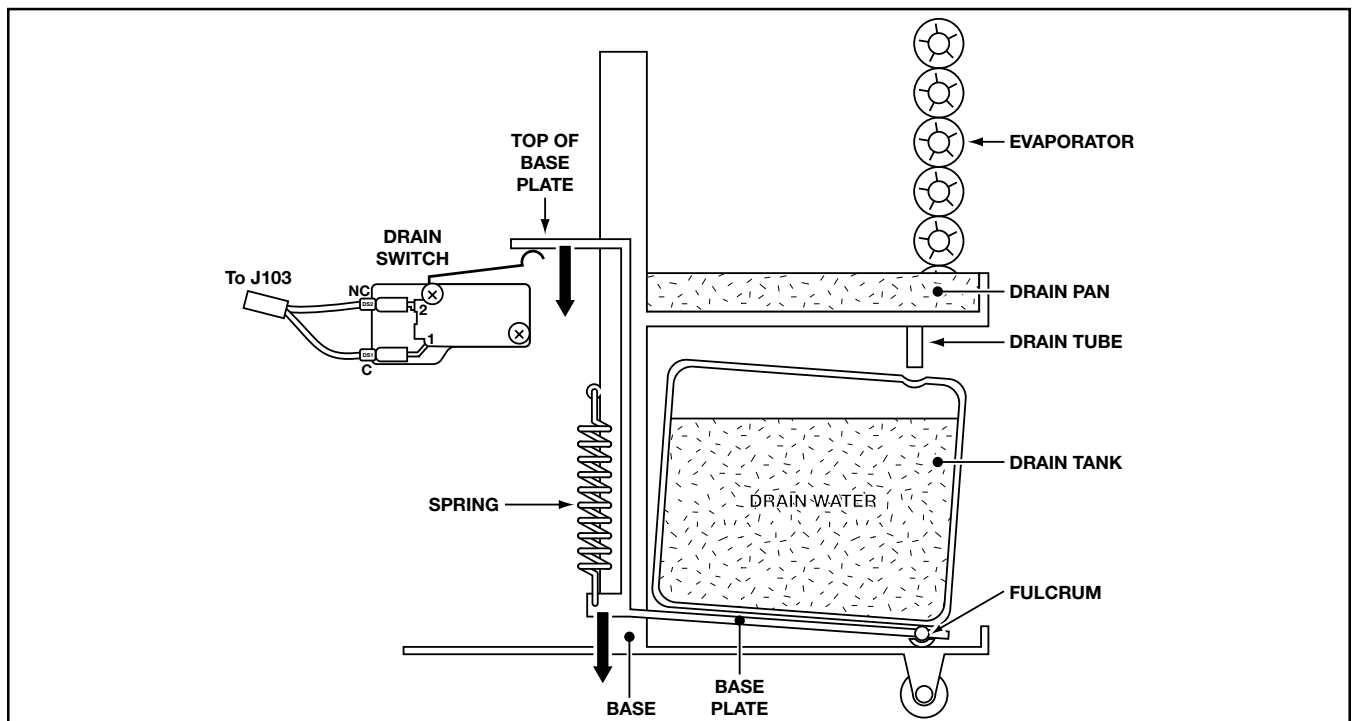


Condensate Pump (Drain Pump)

7. Drain Switch (If drain tank is equipped)

The Office Pro 60 is equipped with a drain tank switch. When the drain tank accumulates approximately 4.0 gallons (15 liters) of condensate (water) in the drain tank, the drain tank switch sends a signal to the microprocessor. The microprocessor stops all operation of the unit and flashes the “Tank Full” LED.

This system utilizes a 0.1 AMP, 250 VAC micro-switch for this function. When drain water accumulates approximately 4.0 gallons (15 liters) in the drain tank, the drain tank base plate, which is supported at its fulcrum, is pushed down in the arrow direction as shown in the figure below. When the drain tank base plate is forced down, the top of the drain tank base plate turns off the contacts (1) – (2) of the micro switch.



Operation of Drain Switch

ELECTRICAL SYSTEM

This causes the ground signal at the J103 connector of the control panel assembly to close. When the microprocessor detects this event, it shuts the unit off and flashes the “Tank Full” LED.

When the drain tank is removed (or the drain tank is emptied), the top of the drain tank base plate returns to its original position from the tension of the coil spring. Then contacts (1) – (2) of the drain tank switch open. This provides a ground to the microprocessor through the J103 connector.

8. How to re-start the unit

If the program “Run” LED is flashing, press the “Cool On/Off” button to continue running the program. If the program “Run” LED is illuminated continuously (program activated), no further steps are necessary. If no program exists or the program was “deactivated”, press one of the fan mode buttons or the “Cool On/Off” button. The unit will return to the previous Temperature Set Point.

9. Automatic Restart after Power Interruption

The program within the microprocessor of the Office Pro 60 contains a feature that will automatically re-start the unit after power is lost and then regained. The unit also has memory in order to return itself back to the operating mode (either Manual or Preset Program) it was in prior to the loss of power. Any “Preset” Program will also be retained in the memory in the event power loss occurs.

10. Compressor Protection

There is a Time Delay program within the microprocessor. This prevents a heavy load from being applied on the Compressor Motor when restarting the unit (Cool Mode) after a very short period of time. This “delay” is in effect any time when the compressor is turned on by either the “Cool On/Off” button, temperature set point (thermostatic control), power interruption restart or Condensate Pump operation.

Time Delay Program Specifications: 120 ± 10 sec.

11. Temperature Control

The compressor operation (Cool Mode) is controlled by the microprocessor which receives input signals from the room temperature thermistor (evaporator inlet air) and the setting of the Temperature Set Point. The Temperature Set Point (desired room temperature) can be adjusted by pressing the ▲ / ▼ buttons on the Control Panel. The adjustment range of the Temperature Set point is 65°F to 105°F (18°C to 40°C).

12. Fan Mode Control Switch

The fan motor operation is controlled by relays on the relay board through a microprocessor in the control panel assembly. The fan program in the microprocessor can be changed by a DIP-Switch on the upper right side of the Relay Board located in the Control Box. There are two settings:

A. Cool to Stop

When the DIP-Switch is set to the left or “Stop” position, the microprocessor controls the fan motor using the same room temperature thermistor that it uses to control the compressor. In this case, both the fan and the compressor stop when the microprocessor receives a sufficiently low intake air (room temperature) signal from the thermistor (equal to or less than the set point). When the temperature increases (exceeds the set point) the microprocessor will restart the fans and the compressor automatically. However, if the unit has been off for less than 75 sec., the evaporator fan will start at the same time as the compressor (time delay program).

B. Cool to Operate

When the DIP-Switch is set in the right or “Operate” position, the microprocessor controls the fan operation using control panel inputs only. The fan will operate continuously during Fan Only and Cool Modes. (This is the “Factory Default” setting.)

13. Temperature Scale Display Switch

When the DIP Switch is set in the left or °C position, the Set Point and Room Temperature will be displayed in degrees Celcius (°C). The LED that indicates °C will also be illuminated.

When the DIP Switch is set in the right or °F position, the Set Point and Room Temperature will be displayed in degrees Farenheit (°F). The LED that indicates °F will also be illuminated (this is the “factory default” setting).

TROUBLESHOOTING AND REPAIR

Before troubleshooting the system, the following inspection should be performed.

1. Inspection of Power Source Voltage

Check the voltage of the power source.

Single phase 230 volts (60Hz)

Check the operation and condition of the fuse or circuit breaker in the power source.

2. Inspection of Air Filters

Remove the air filters and check the element. If the element is dirty, wash it as described in the OPERATION MANUAL supplied with the unit.

3. Inspection of Drain Tank (If equipped)

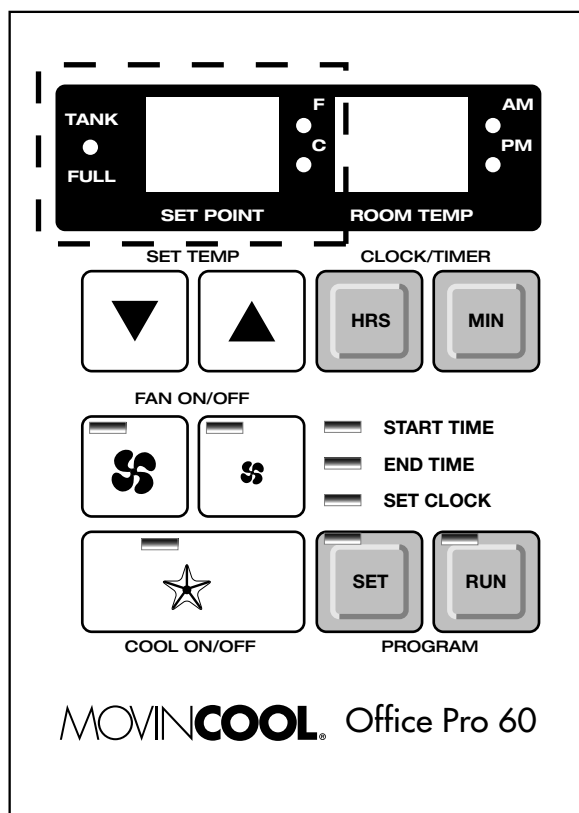
Be sure tank is fully drained.

The following chart is provided as a guide for categorized problem remedies. Detailed information is contained in the OPERATION MANUAL supplied with the unit.

4. Self-Diagnostic Codes

Self-Diagnostic codes will be displayed on the control board under the following conditions:

- dF** When the evaporator anti-freeze thermistor disengages the compressor.
- FL** When the drain tank switch shuts off the unit (full tank LED flashes).
- AS** When unit disengages the compressor while the condensate pump is discharging water.
- HP** When the high pressure switch disengages the compressor.



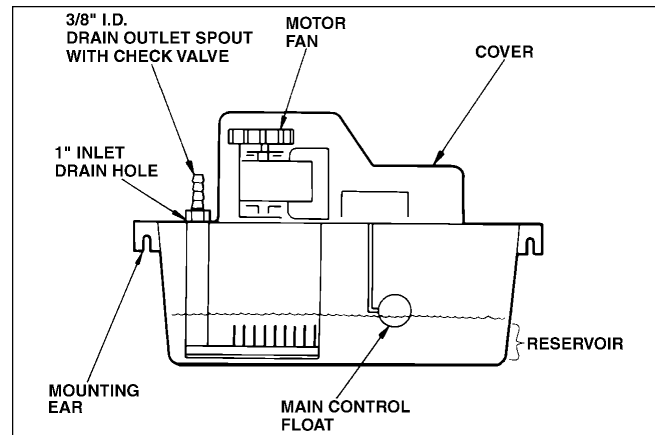
OP60 Control Panel

TROUBLESHOOTING AND REPAIR

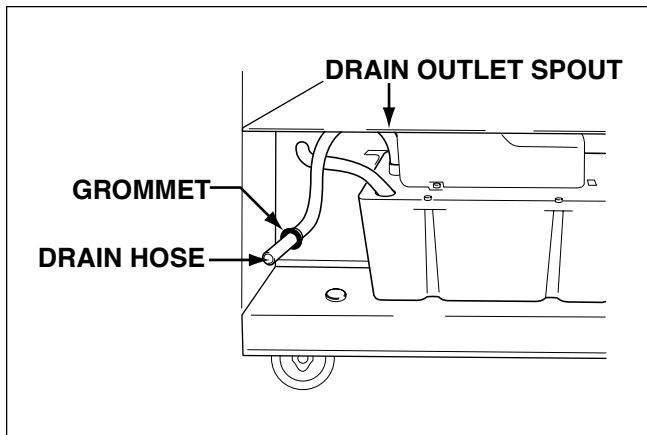
5. Pump Maintenance

WARNING: When performing any maintenance and/or troubleshooting, make sure that all electrical power is off. This means before service, unplug the unit from the electrical outlet or if permanently wired, make sure the circuit breaker is in the off position.

- 1) **Remove any dirt or debris which may collect in the bottom of the reservoir tank.**
- 2) **On a monthly basis, check the condensate drain hose for kinks, blockage or any other damage that may obstruct condensate pump from draining properly.**
- 3) **Always replace the fan motor cover to keep electrical parts free of dust, dirt and any other foreign material.**



TROUBLESHOOTING AND REPAIR



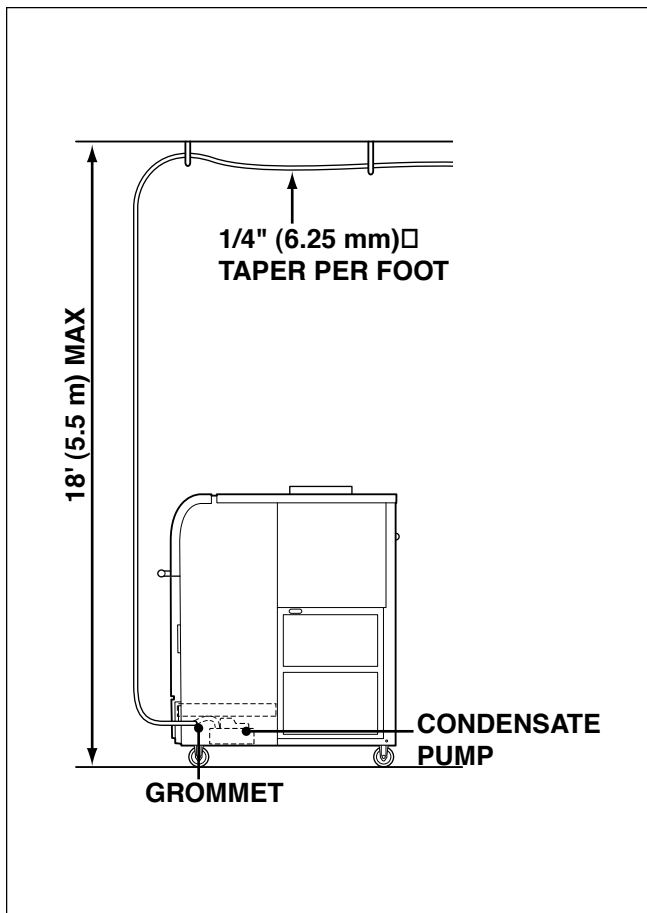
6. Hose Installation

Note: The OP60 is equipped with a 20 foot (6 m) hose.

Feed the 20 foot (6m) hose through the grommet on the right side of the unit and connect to the drain outlet spout.

Note: Do not use more than 18 feet (5.5 m) of drain hose vertically. This is the maximum head (lift) of the Condensate Pump.

When securing the drain hose to the highest vertical position (no more than 18 feet (5.5m)) and running the hose to the drain, run the drain hose on a downward slope at a minimum of 1/4 inch (6.25 mm) per foot for proper drainage.



TROUBLESHOOTING AND REPAIR

7. Troubleshooting Chart

Trouble	Probable Cause	Trouble	Probable Cause
Unit does not operate at all	• Check for Power at Receptacle • Fan mode DIP switch is set to "Stop" and current Set Point Temperature exceeds Room Temperature • Fan mode DIP switch is set to "Stop" and unit has Condensate Pump that is defective • Check for Power at Terminal Block • Check for Power at Relay Board • Check all wire connections • Defective Drain Tank Switch • Check Relay Board Fuse • Defective or Incorrect Relay Board • Defective Control Board	Insufficient Air Flow	• Clogged fins on Evaporator or Condenser (running unit without filter(s)) • Fan on "Low" setting • Defective fan motor • Static pressure exceeds design specifications
		Insufficient Cooling	• Environmental conditions exceed design specifications • Clogged air filter • Clogged fins • Set point temperature exceeds room temperature • Defective room temperature thermistor • Exhaust outlet not properly ducted • Leak in refrigerant system • Restriction in refrigerant system
		Display not working	• Compressor not operating
Unit starts, but stops immediately	• Room temperature and anti-freeze thermistor connectors are reversed on control board • Defective Fan Motor • Defective Compressor Motor • Defective Relay Board	Compressor not operating	• Set point temperature exceeds room temperature • Unit is operating in Fan Only Mode (Cool Mode not activated) • Defective Condensate Pump • Defective Compressor Capacitor • Defective Thermistor • Defective Compressor Motor • Check wiring connections • Defective Relay Board • Defective Control Board
Unit operates, but stops after a few minutes	• Drain Tank Switch activated • Fan Mode Switch is set to "Stop" and unit reached "set point" temperature so compressor cycled off • Defective Compressor Motor • Defective Fan Motor • Fan Mode Switch is set to "Stop" and compressor cycled off		
Water leakage from the unit	• Condensate pump not working • Drain Tank not installed • Drain Tank (if available) is defective (cracked) • Drain Pan hole is obstructed • Drain hose kinked	Evaporator or Condenser Fan Motor(s) not operating	• Fan mode DIP switch is set to "Stop" and current Set Point Temperature exceeds Room Temperature • Fan mode DIP switch is set to "Stop" and unit has Condensate Pump that is defective • Check wire connections • Defective fan motor capacitor • Defective fan motor • Defective Relay Board • Defective Control Board
Abnormal noise and/or shaking	• Loose Compressor mounting nut • Deformed or worn rubber grommet on the compressor mounting bolt • Internal interference with other components • Damaged or out of balance fan		

TROUBLESHOOTING AND REPAIR

In case of trouble, perform the following inspection before disassembly.

8. Inspection of Plate Fins

To inspect the plate fins of either the evaporator or condenser you must remove the air filters. After removal of the air filters, inspect the plate fins for any dirt, dust, lint, or debris that may have caused poor cooling performance of the unit. If cleaning of the fins is necessary, it is recommended that this service be performed by a qualified service technician.

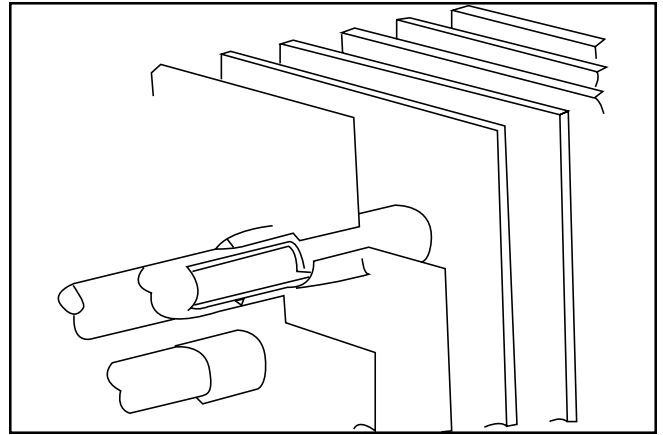
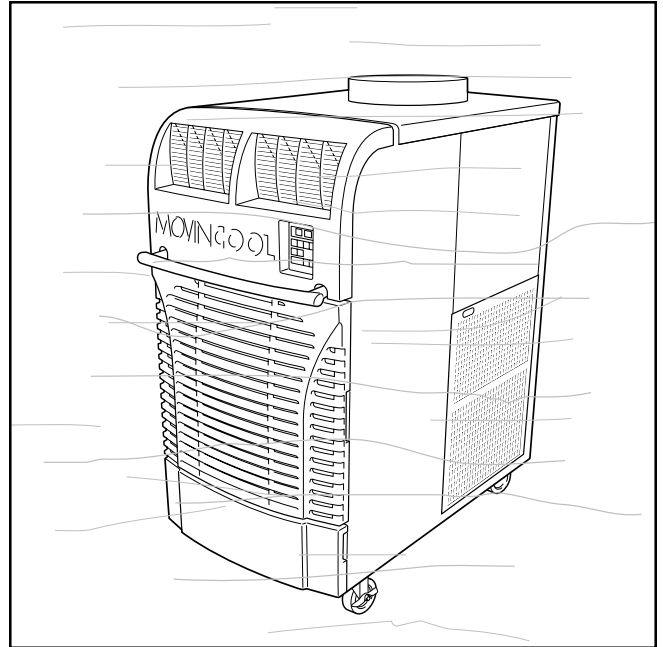


Plate Fins

9. Examination of Operating Environment

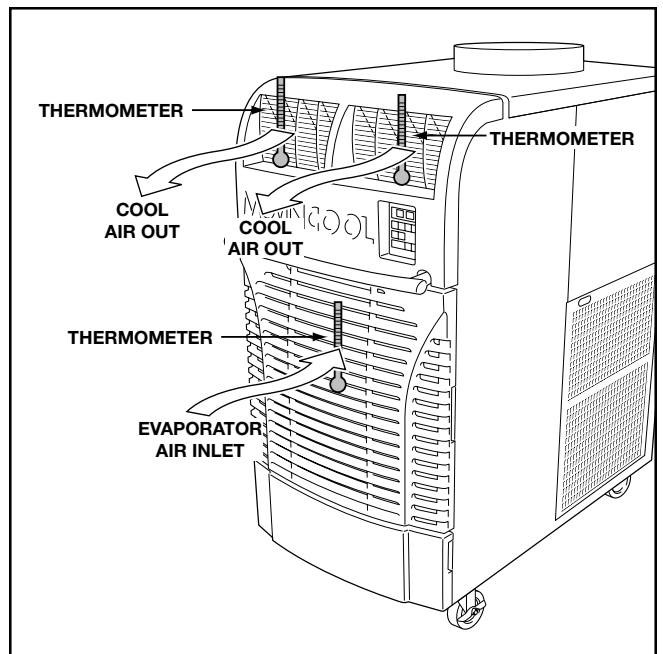
Operating environments will vary depending on location, climate and surrounding conditions. Installation location also can cause operational problems. Consult your reseller concerning operational environment requirements.



Operating Environment

10. Inspection of Cooling Capacity

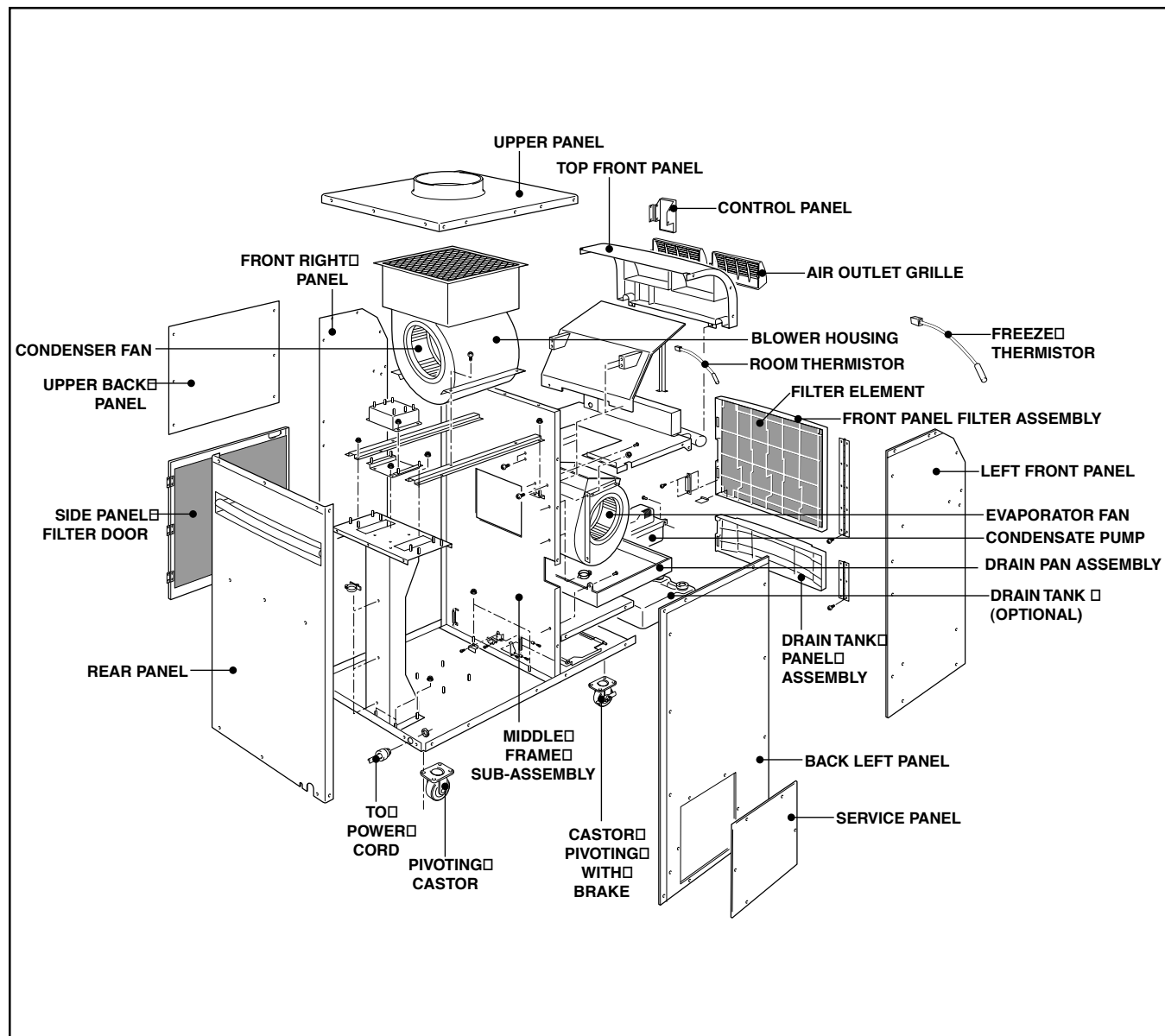
Measure the difference in temperature between the inlet of the evaporator and the cool air vent. If the difference is out of the range given in the graphs on page 8, proceed with the possible causes suggested in the troubleshooting chart on page 24.



Cooling Capacity

TROUBLESHOOTING AND REPAIR

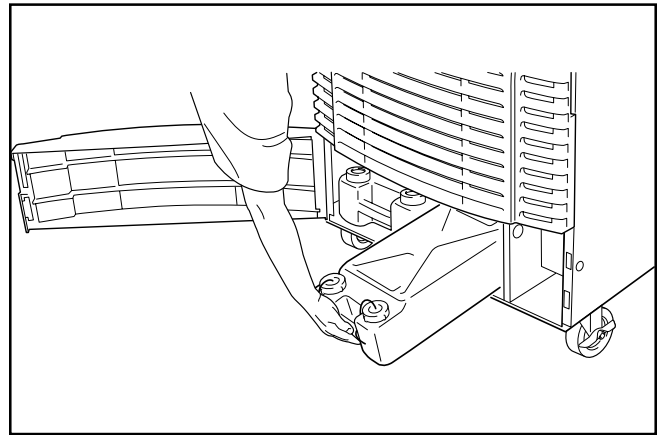
11. Disassembly



Disassembly

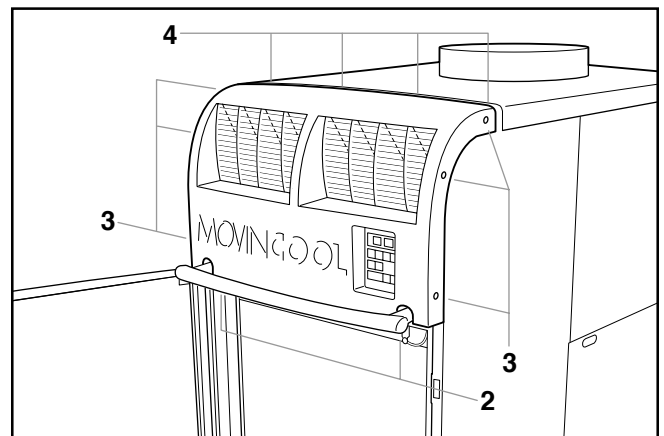
TROUBLESHOOTING AND REPAIR

- A. Remove drain tank (if equipped).



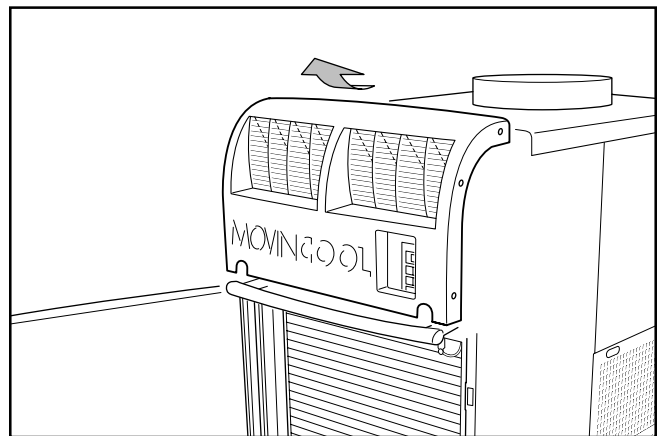
Removal of Drain Tank (if equipped)

- B. Remove twelve (12) screws from upper front panel.



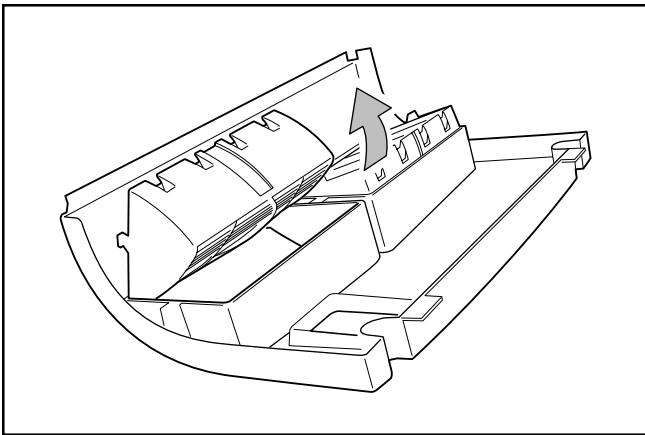
Removal of Upper Front Panel Screws

- C. Slide upper front panel forward and remove.



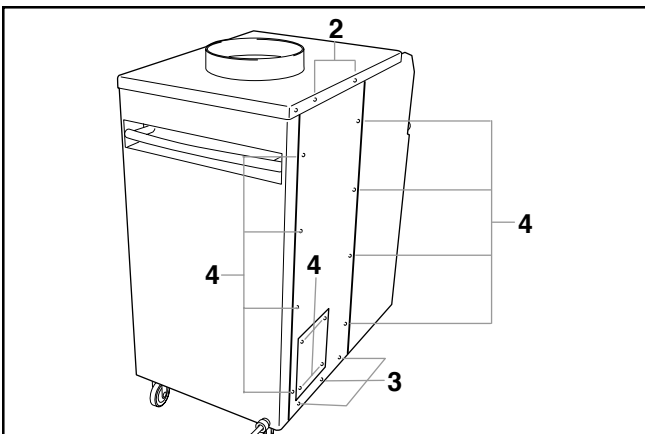
Removal of Upper Front Panel

TROUBLESHOOTING AND REPAIR



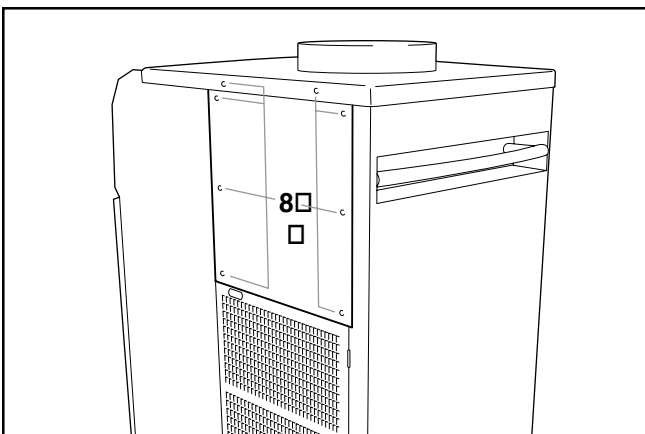
Removal of Air Outlet Louver

- D. Louver can be removed from upper front panel by unsnapping the lock tab and removing the louver from its pivots.



Removal of Service Panel and rear panel

- E. Remove thirteen (13) screws from left rear panel. Then remove four (4) screws from the service panel.

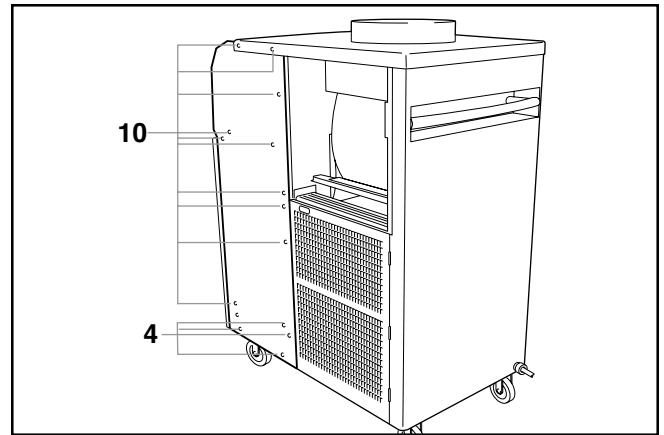


Removal of upper rear panel

- F. Remove eight (8) screws from right upper rear panel.

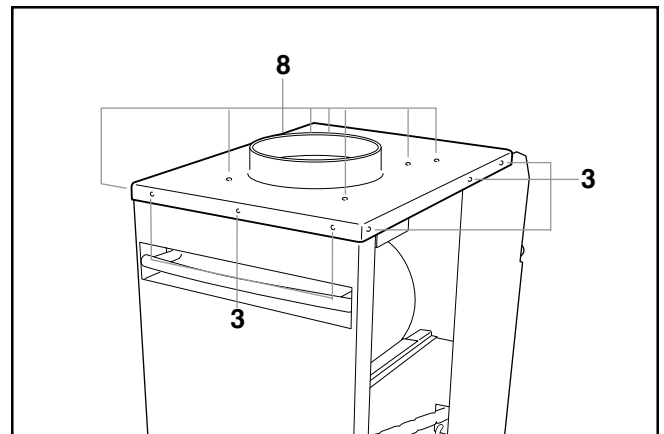
TROUBLESHOOTING AND REPAIR

- G. Remove fourteen (14) screws from right front panel.



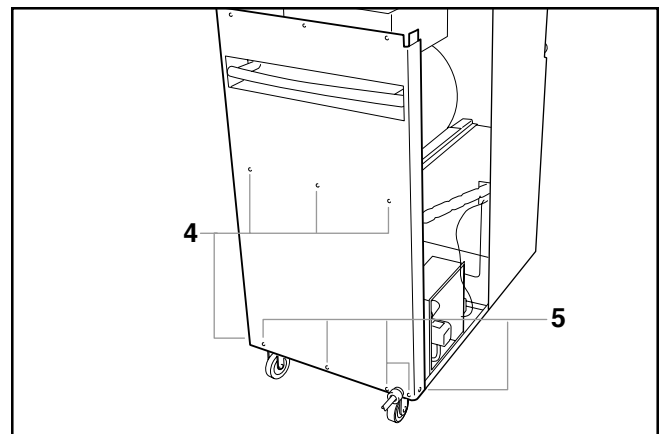
Removal of right front panel

- H. Remove fourteen (14) screws from upper panel.



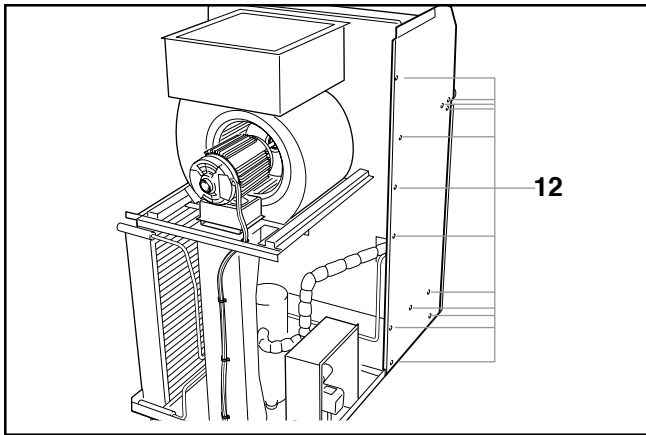
Removal of upper panel screws

- I. Remove nine (9) screws from rear panel.



Removal of back panel screws

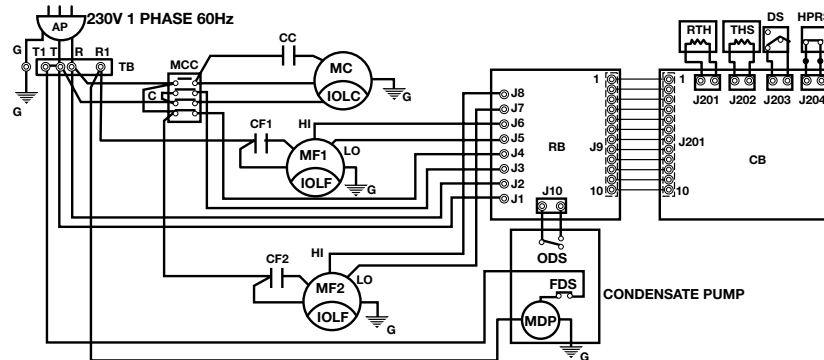
TROUBLESHOOTING AND REPAIR



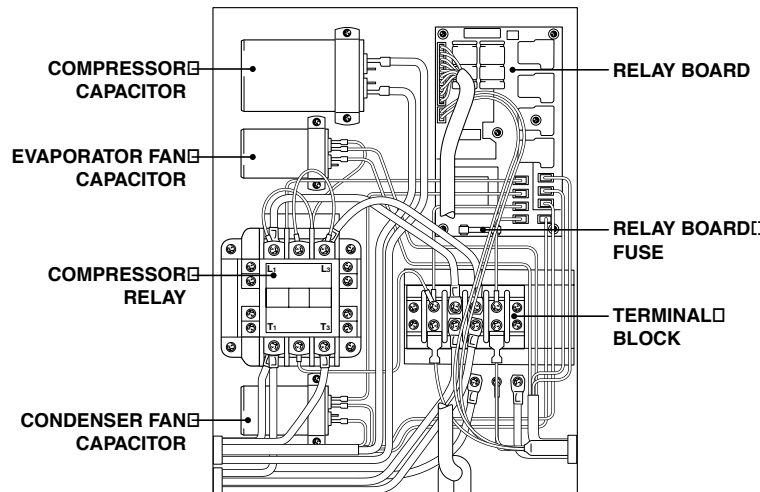
Removal of left front panel

- J. Remove twelve (12) screws from left front panel.

12. Removal of Electrical Parts

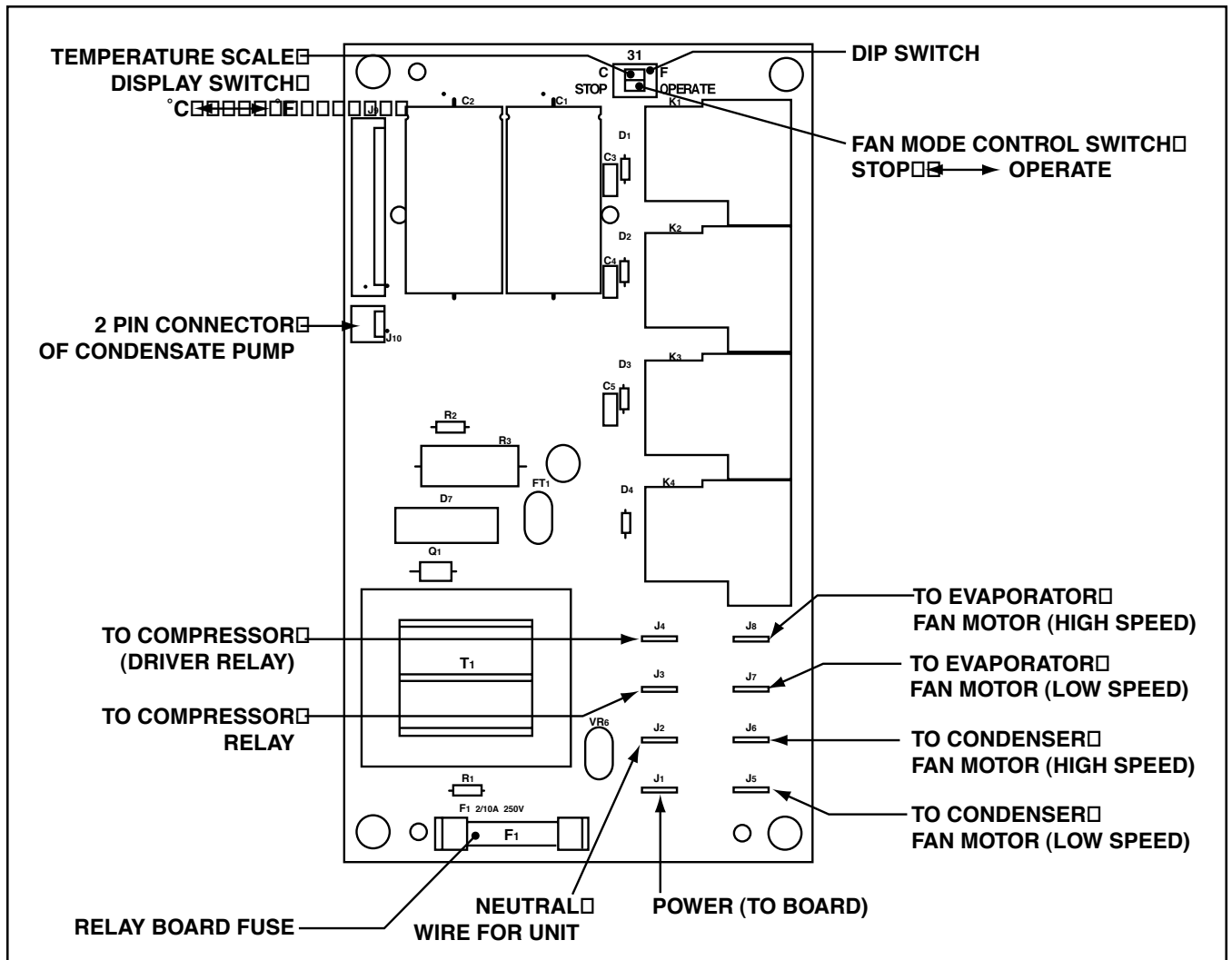


AP	Attachment Plug	IOLC	Inner Overload Relay of Compressor
TB	Terminal Block	DS	Full Drain Tank Warning Switch
CB	Control Board	THS	Freeze Protection Thermistor
RB	Relay Board	RTH	Room Thermistor
MF1	Condenser Fan Motor	G	Ground
MF2	Evaporator Fan Motor	HPRS	High Pressure Switch
MC	Compressor Motor	MCC	Relay for Compressor and Condenser Motor
CF1	Capacitor for Condenser Fan Motor	MDP	Condensate Pump Motor
CF2	Capacitor for Evaporator Fan Motor	FDS	Drain Float Switch
CC	Capacitor for Compressor	ODS	Drain Overflow Switch
IOLF	Inner Overload Relay of Fan Motor	J10	Connector for Condensate Pump

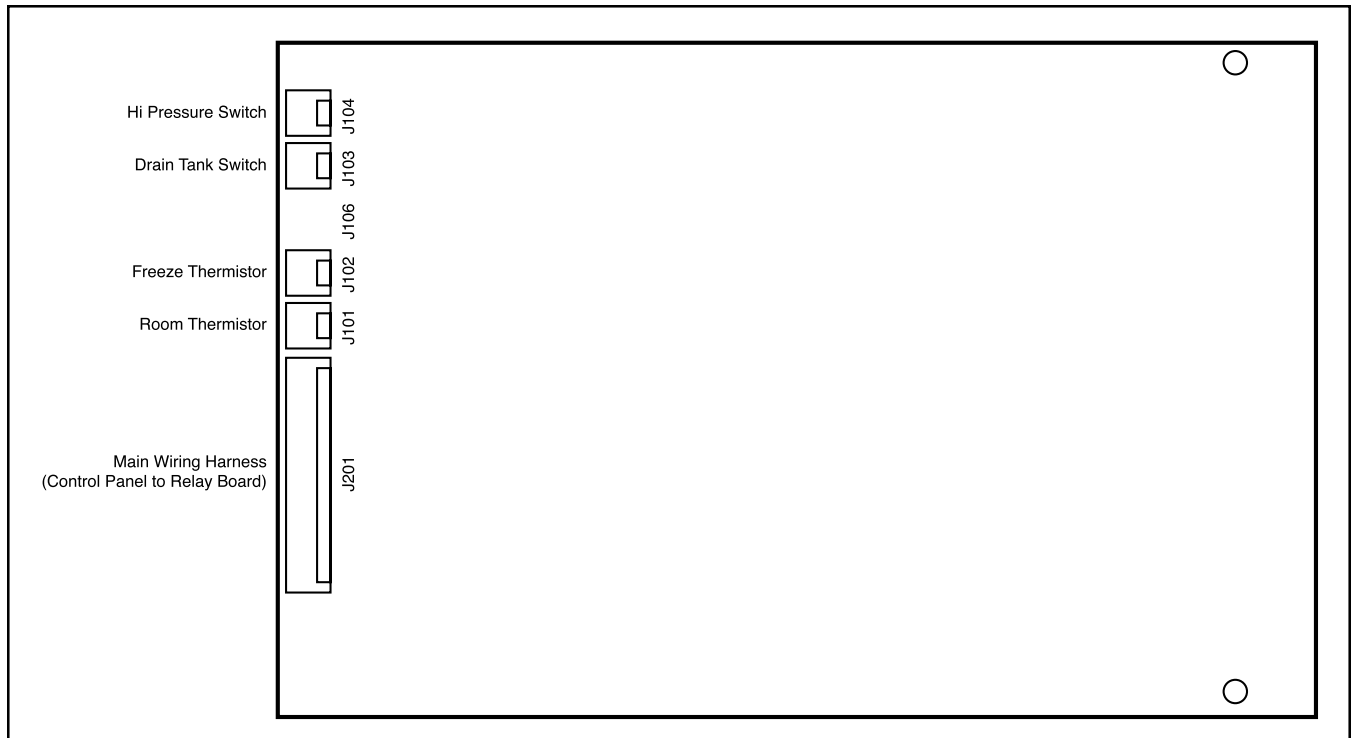


Removal of Electrical Parts in the Control Box

TROUBLESHOOTING AND REPAIR



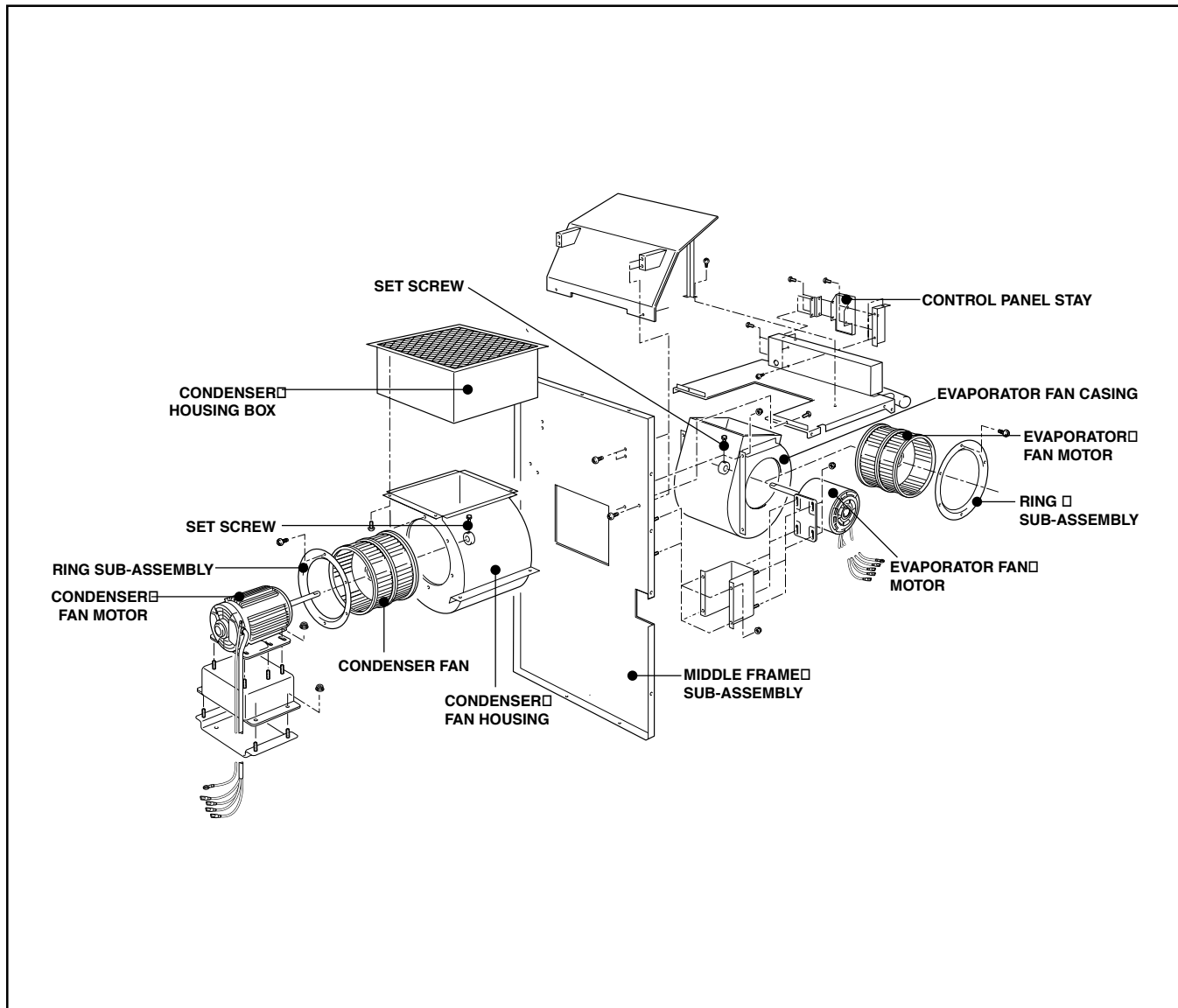
Connections to Relay Board



Connections to Control Board

TROUBLESHOOTING AND REPAIR

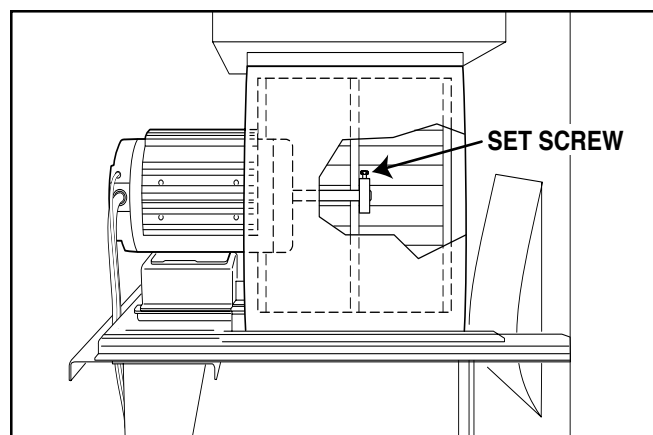
13. Removal of Blower Assembly



Disassembly of Blower

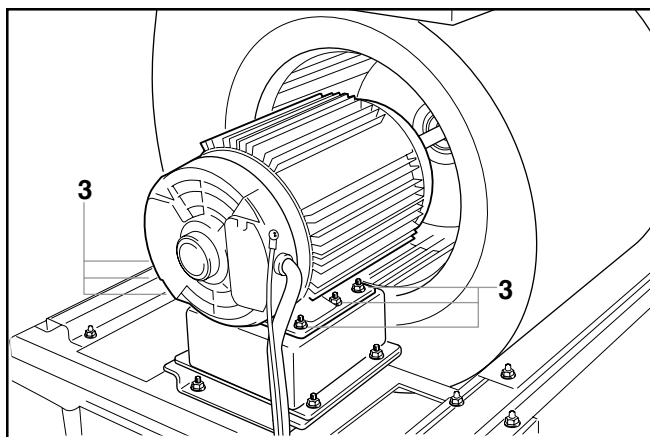
14. Removal of Condenser Fan Motor

- A. Loosen the set screw using a 5/16" open ended wrench.

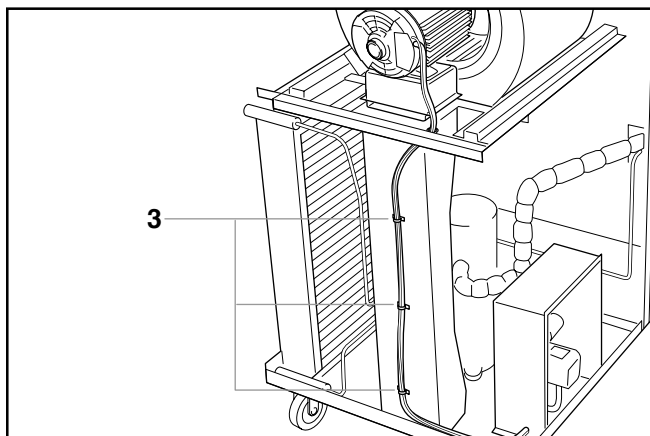


Removal of Centrifugal Fan

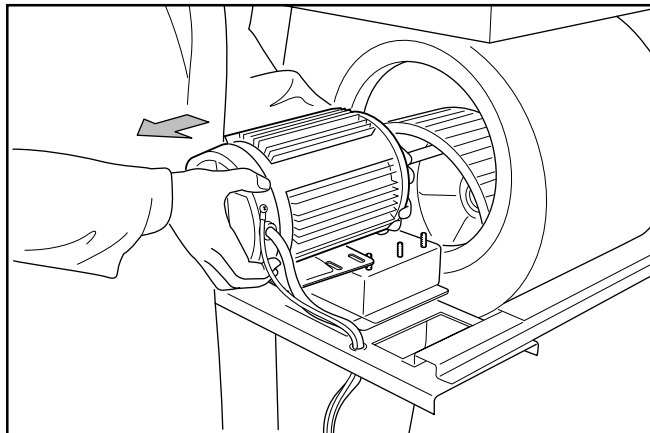
TROUBLESHOOTING AND REPAIR



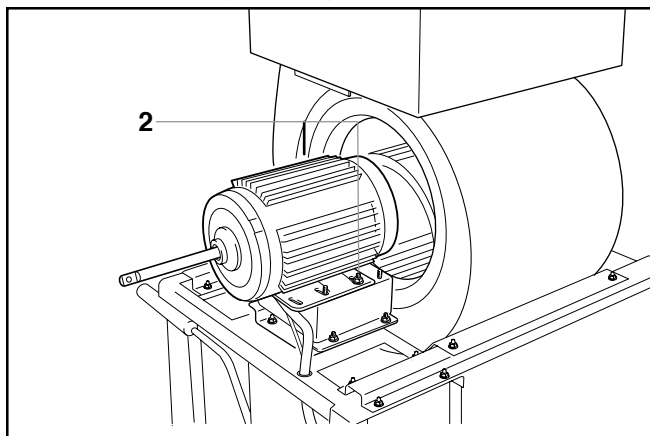
Removal of Blower Housing



Removal of Fan Motor Assembly



Removal of Fan Motor (Condenser)



Removal of Fan Motor

B. Remove the six (6) nuts on the inside of the housing in the locations shown.

C. Remove motor wires from the three (3) motor wiring ties.

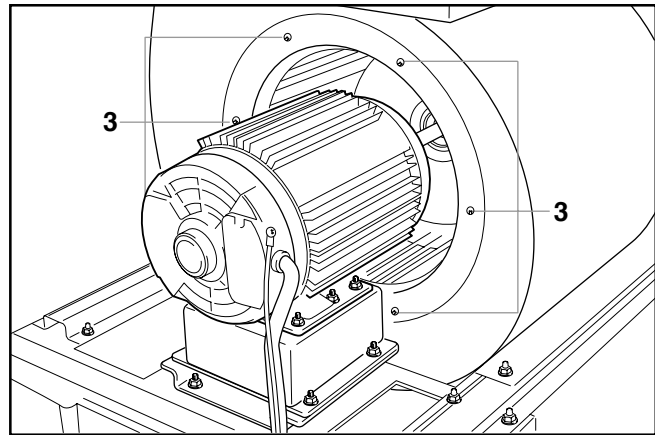
D. Lift fan motor up then pull rear motor forward and remove. Centrifugal fan will drop into condenser fan housing.

Removal of Condenser Fan

A. Rest the fan motor backwards and place on mounting bracket. Secure motor with two (2) nuts.

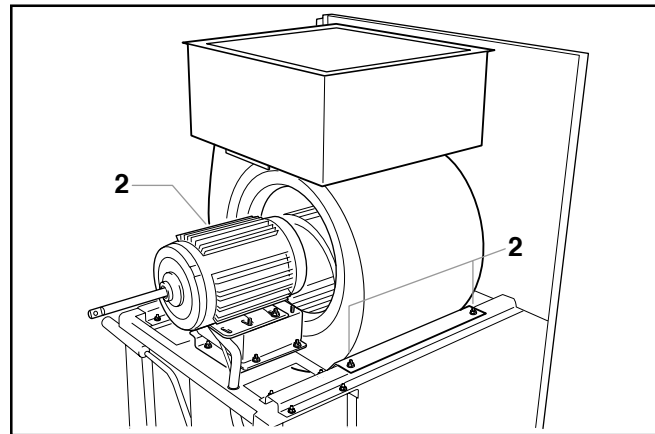
TROUBLESHOOTING AND REPAIR

- B. Remove the ring sub-assembly by removing the six (6) screws.



Removal of Ring Sub-Assy

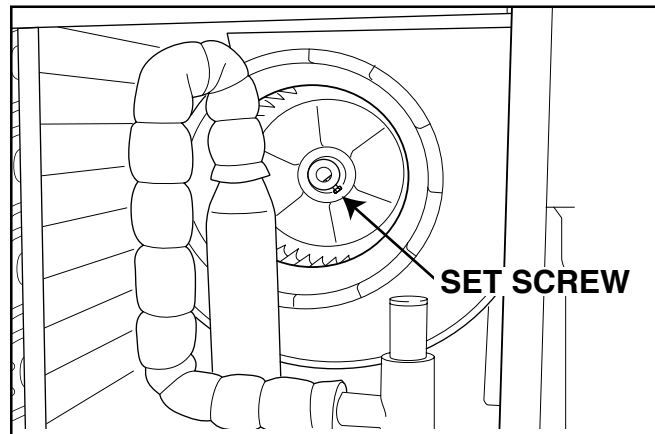
- C. Loosen the four (4) nuts securing the fan casing. Lift the enclosure off its mounting. Slide the condenser fan out through opening.



Removal of Fan Casing Nuts

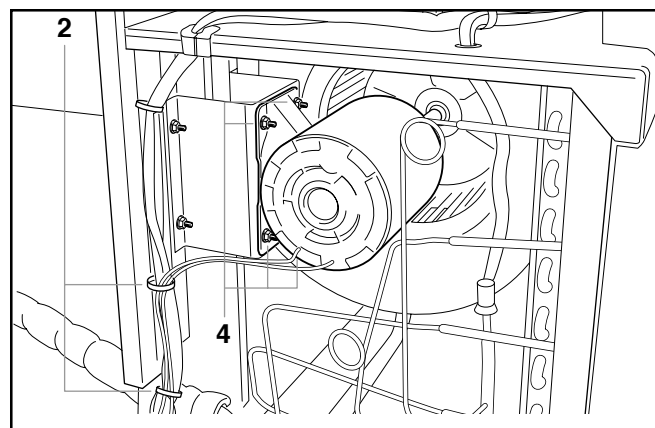
Removal of Evaporator Fan Motor

- A. Loosen the set screw using a 5/16" open ended wrench.



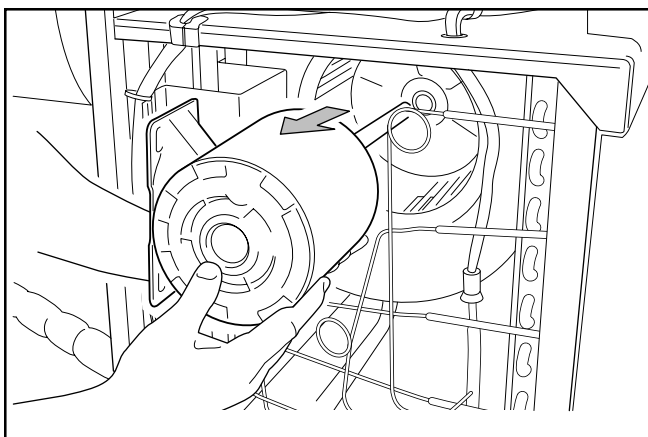
Loosening of Set Screw

- B. Remove four (4) nuts from housing while holding fan securely with one hand. Remove motor wires from the two (2) front motor wiring ties.



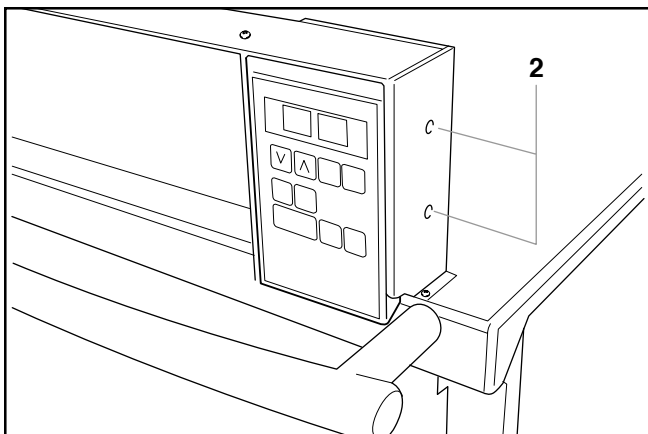
Removal of Fan Housing Nuts

TROUBLESHOOTING AND REPAIR



Removal of Fan Motor (Evaporator)

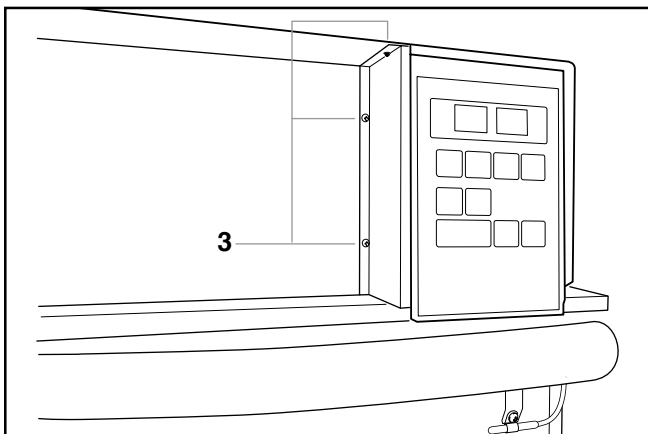
C. Pull evaporator motor forward and remove.



Removal of Control Panel Screws

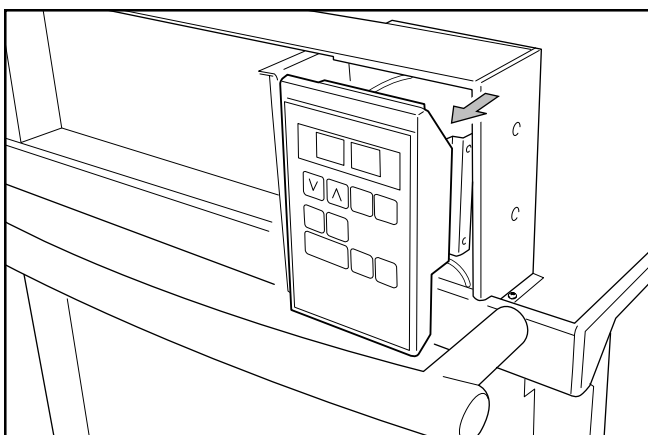
Removal of Control Board

A. Remove two (2) screws from the control panel stay.



Removal of Control Panel Screws

B. Remove three (3) screws from the control panel stay.



Removal of Control Board

C. Slowly slide control panel assembly out of box.

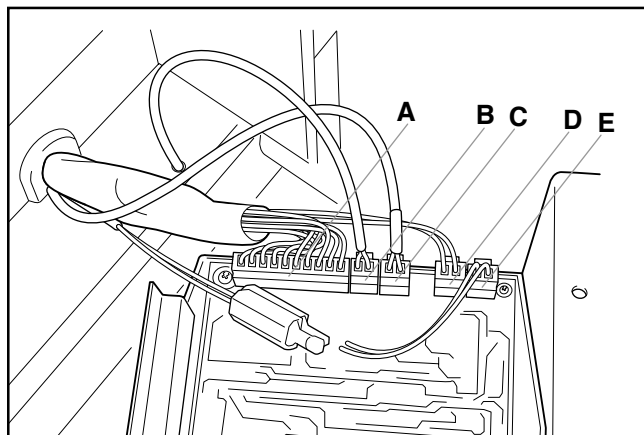
TROUBLESHOOTING AND REPAIR

D. Disconnect the following connectors from the control board:

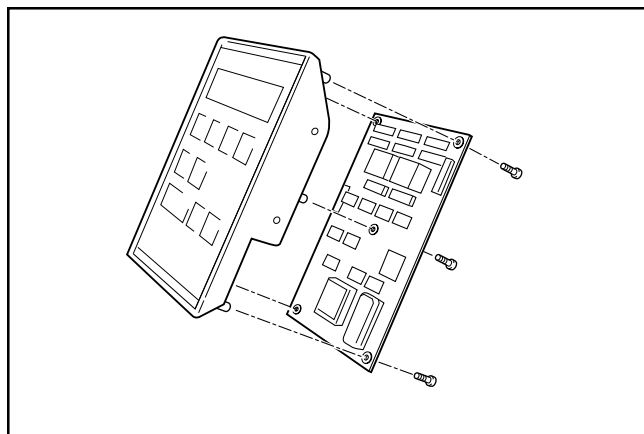
- (A) Wire Harness, Relay Board to Control Board J201 (10-pin)
- (B) Room Thermistor J101 (2-pin)
- (C) Freeze Thermistor J102 (2-pin with black tape)
- (D) Drain Tank Switch J103 (2-pin)
- (E) High Pressure Switch Sub-Harness

NOTE: Mark each of the 2-pin connectors with a different color marker to ensure the correct orientation when they are re-connected.

E. Remove the five (5) screws from the control board on the control panel assembly. Remove the control board.



Removal of Connectors from Control Panel



Removal of Control Board

15. Inspection of Capacitor (for Fan Motors and Compressor)

Ohmmeter Method – Set the ohmmeter to the 100K Ω range. Place the two probes against the two terminals of the capacitor. At first, the ohmmeter should indicate 0 Ω , then the reading should gradually increase towards infinity (∞). This indicates that the capacitor is charging. If the reading indicates infinity right away (shorted) or the ohmmeter fails to move from 0 Ω (open), replace the capacitor.

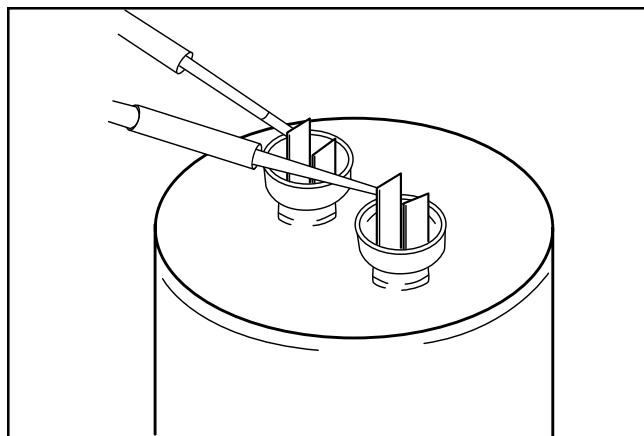
16. Capacitance Tester Method

Using a capacitance tester and the chart on page 17, test the capacitor for the value indicated. If the value tested is not within 10% of indicated capacitance, replace the capacitor.

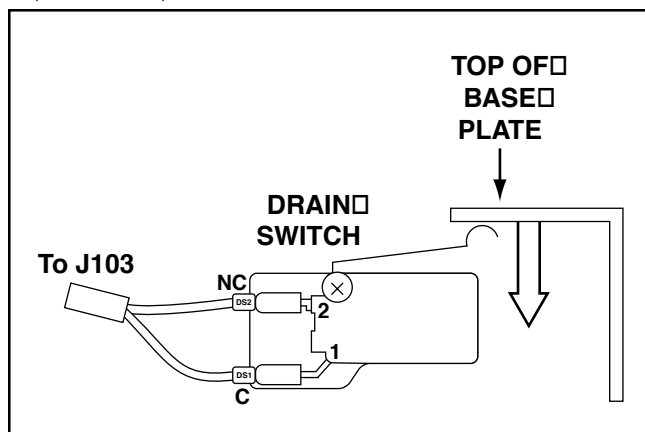
⚠WARNING: Properly discharge the capacitor(s) before testing and after testing has been completed. Failure to do so could cause damage to test equipment or the unit and/or result in personal injury (electrical shock) or death.

18. Inspection of Drain Switch

Check for continuity between terminals 1 and 2. Continuity should exist. With switch depressed, no continuity should exist between terminals 1 and 2. If continuity is not as specified above, replace the switch.

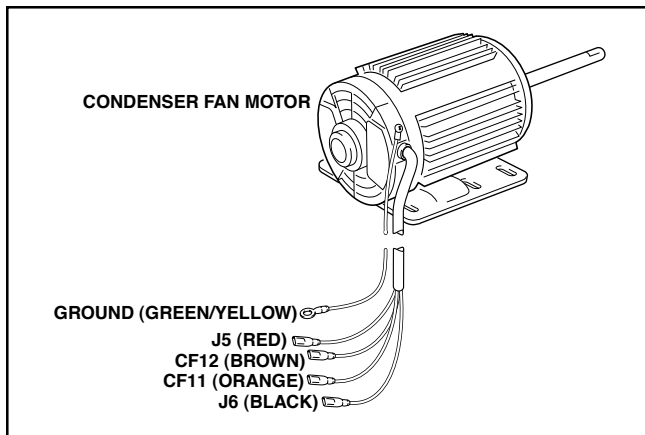


Inspection of Capacitor

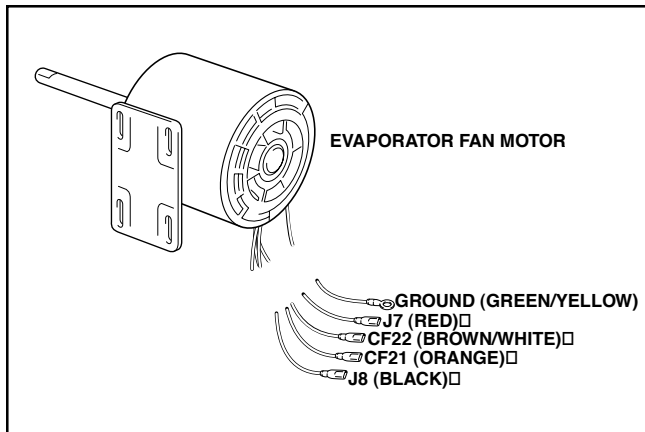


Inspection of Drain Switch

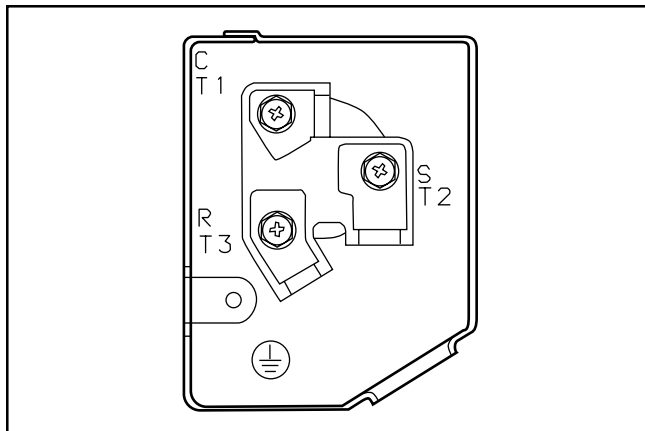
TROUBLESHOOTING AND REPAIR



Inspection of Condenser Fan Motor



Inspection of Evaporator Fan Motor



Inspection Of Compressor Motor

17. Inspection of Condenser Fan Motor

Measure resistance across the terminals of the fan motor.

Terminals (at 77°F (25°C))

J6-CF12 Approx. 21.2Ω

J5-CF11 Approx. 32.4Ω

J5-J6 Approx. 0.592Ω

If the measured resistance does not approximately equal these standard values $\pm 10\%$, replace the fan motor.

18. Inspection of Evaporator Fan Motor

Measure resistance across the terminals of the fan motor.

Terminals (at 77°F (25°C))

CF21-J8 Approx. 1.55Ω

CF22-J8 Approx. 70.2 Ω

J7-J8 Approx 89.7 Ω

If the measured resistance does not approximately equal these standard values $\pm 10\%$, replace the fan motor.

19. Inspection of Compressor Motor

Measure resistance across the terminals of the compressor motor.

Terminals (at 77°F (25°C))

R-C Approx. 2.0Ω

C-S Approx. 2.2Ω

S-R Approx. 3.8Ω

If the measured resistance does not approximately equal these standard values $\pm 10\%$, replace the fan motor.

TROUBLESHOOTING AND REPAIR

20. Inspection of Wiring Connection

Refer to the Wiring Diagrams on page 46 and check for connection of each wire.

21. Inspection of Thermistor

Using an Ohmmeter, check the resistance value across the 2-pin connector. At normal temperature (77°F (25°C)) either thermistor (room or freeze) should measure approximately 10,000 or 10K ohms.

22. Inspection

In most cases, the probable cause for insufficient cooling is a clogged system, too much static pressure refrigerant leakage, or an incorrect amount of refrigerant. In such cases, inspect the system according to the following procedure.

A. Inspection of Clogged System

Check the component parts of the refrigerant system, including piping, that could be clogged with refrigerant. If clogged with refrigerant, only the clogged part is frosted partially. In such a case, change the part in question.

B. Inspection of Refrigerant Leak

Carefully check all connections, and each component for leaks whenever the refrigerant system is installed or repaired. Use an electronic gas leak tester to inspect the system.

C. Insufficient Refrigerant

In case the unit is judged to be deficient in cooling capacity, be sure to perform the inspections in 24A and 24B to confirm the cause of trouble. After that, charge the system with refrigerant to the specified amount.

23. Repair of Refrigerant System

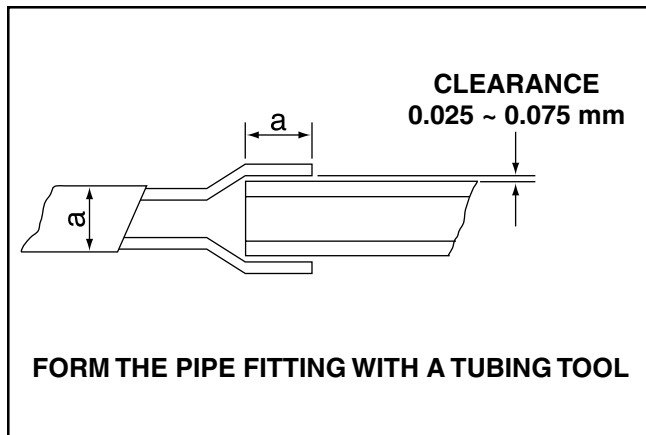
In case there is a leak, obstruction, or trouble in the refrigerant system of the Spot Cooling System, replace or repair the part in question. After replacing any component all connections must be brazed.

A. Proper Brazing Techniques

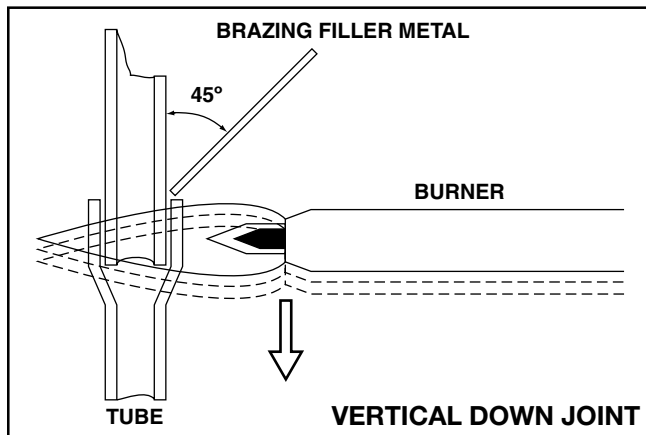
It is desirable to use a slightly reducing flame. Oxyacetylene is commonly used since it is easy to judge and adjust the condition of the flame. Unlike gas welding, a secondary flame is used for brazing. It is necessary to preheat the base metal properly depending on the shape, size or thermal conductivity of the brazed fitting.

The most important point in flame brazing is to bring the whole brazed fitting to a proper brazing temperature. Care should be taken to not cause overflow of brazing filler metal, oxidization of brazing filler metal, or deterioration due to the overheating of flux.

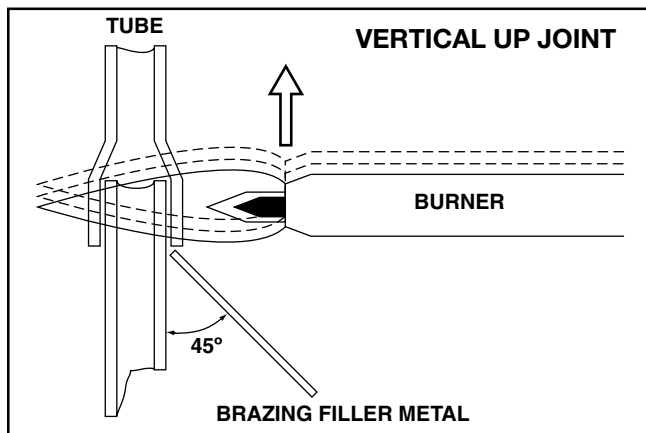
TROUBLESHOOTING AND REPAIR



Form the Pipe Fitting



Vertical Down Joint



Vertical Up Joint

- **BRAZED FITTING AND ITS CLEARANCE**

In general, the strength of brazing filler metal is lower than that of the base metal. So, the shape and clearance of the brazed fitting are quite important. As for the shape of the brazed fitting, it is necessary to *maximize its adhesive area*. The clearance of the brazed fitting must be minimized to facilitate brazing filler metal to flow into it by capillary action.

- **CLEANING OF BRAZING FILLER METAL AND PIPE**

When the refrigerant system has been opened up, exposure to heat may have caused brazing filler metal to stick to the inside and outside of the pipe. Brazing filler metal may also be compounded with oxygen in the air to form oxide film. Fats and oils may stick to the pipe from handling. All these factors will reduce effectiveness of brazing. It is necessary to eliminate excess brazing filler metal using sand paper and by cleaning thoroughly with a solvent such as Trichlene.

- **USE OF DRY NITROGEN GAS**

During brazing, the inside of the pipe undergoes an oxidative reaction due to the brazing flame. Introduce dry nitrogen gas (1l/min.; adjust with the flow regulator) through the pinch-off tube of the refrigerant cycle to prevent oxidation.

NOTE: Take care not to allow dirt, water, oil, etc. to enter into the pipe

- **VERTICAL JOINT**

Heat the whole brazed fitting to a proper brazing temperature. Bring the brazing filler metal into contact with the fitting so that the brazing filler metal starts flowing by itself. Stop heating the fitting as soon as the brazing filler metal has flown into the clearance. Since the brazing filler metal flows easily into the portion heated to a proper temperature, it is essential to keep the whole fitting at a proper brazing temperature.

TROUBLESHOOTING AND REPAIR

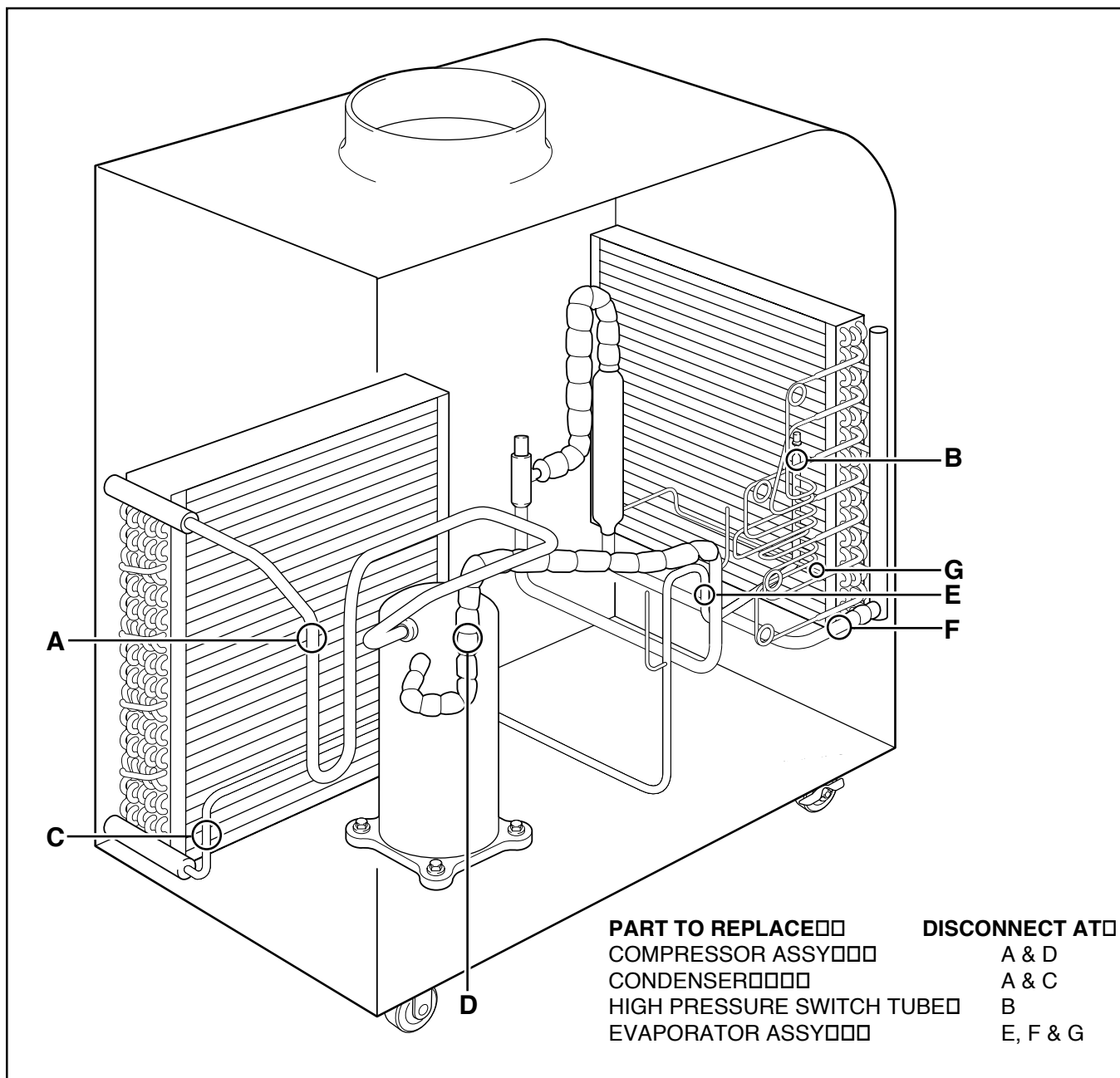
B. Removal of Refrigeration Cycle Components

⚠CAUTION

1. Before any refrigeration cycle component can be replaced, it is necessary to recover the refrigerant using standard recovery procedures and equipment.
2. To prevent oxidation, dry nitrogen should be conducted (flow rate 1l/min) through the pinch-off tube during any brazing operation.
3. During any component replacement involving brazing, shield nearby parts with a steel plate, asbestos, etc., to protect them from the flame.

- (1) Evaporator
- (2) Capillary tubes
- (3) Condenser
- (4) Compressor

NOTE: Hold the compressor body, not the tube, when carrying the compressor.



TROUBLESHOOTING AND REPAIR

24. Charging the System with R-22 Refrigerant

Always ensure that the refrigerant system has been properly evacuated before charging with the specified amount of R-22.

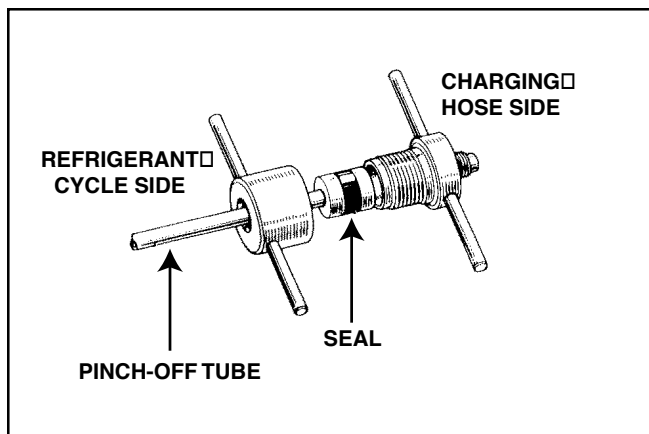
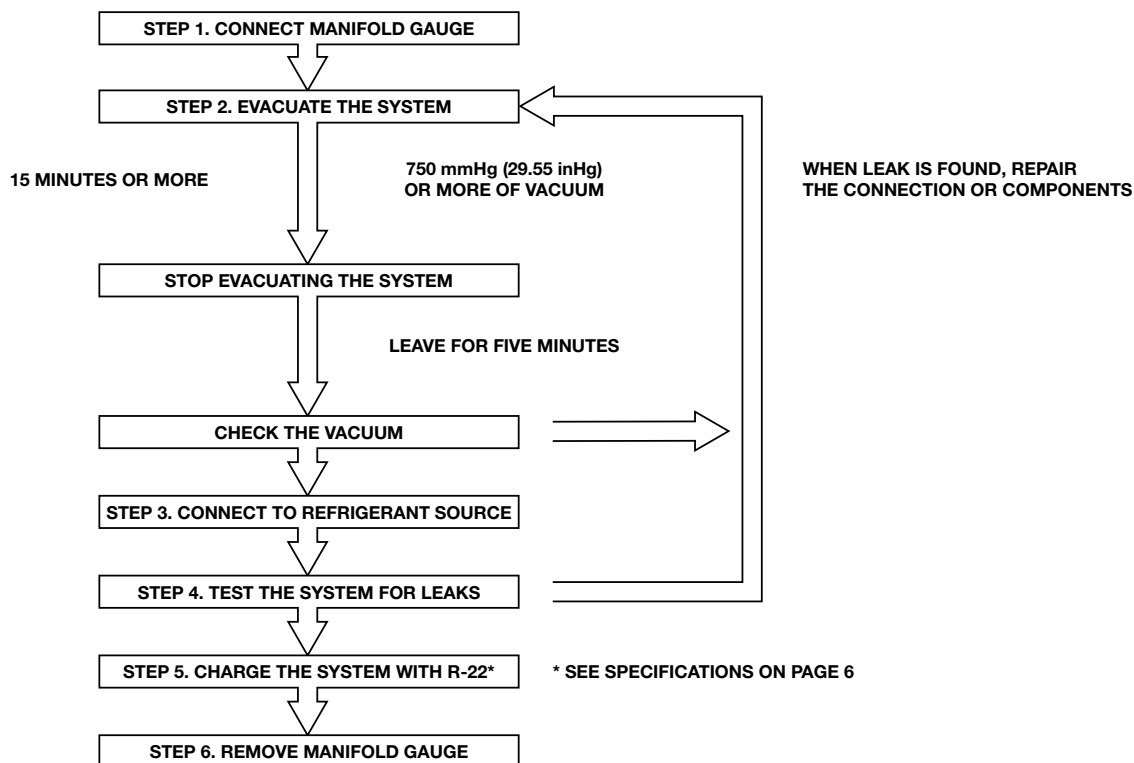
⚠WARNING

When handling refrigerant (R-22), the following precautions should always be observed:

- Always wear proper eye protection while handling refrigerant.
- Maintain the temperature of the refrigerant container below 40°C (104°F).
- Perform repairs in a properly ventilated area. (Never in an enclosed environment.)
- Do not expose refrigerant to an open flame.
- Never smoke while performing repairs, especially when handling refrigerant.
- Be careful the liquid refrigerant does not come in contact with the skin.

If liquid refrigerant strikes eye or skin:

- Do not rub the eye or the skin.
- Splash large quantities of cool water on the eye or the skin.
- Apply clean petroleum jelly to the skin.
- Go immediately to a physician or to a hospital for professional treatment.



Connection of Gauge Manifold

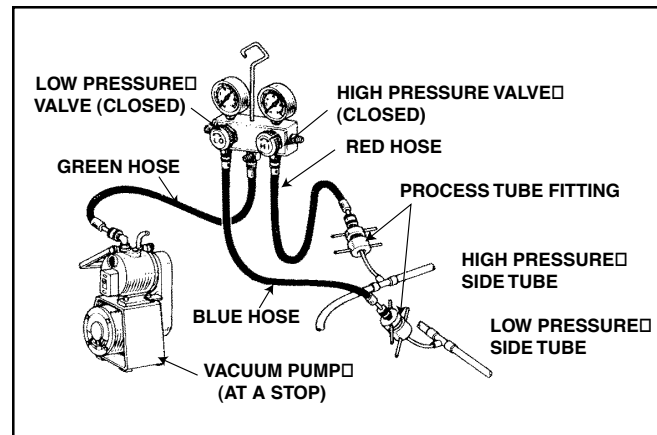
A. Connection of Gauge Manifold

- (1) Properly remove the crushed end of the pinch-off tube at the high pressure side and the low pressure side of the refrigerant cycle with a pipe cutter.
- (2) Fit the process tube fitting to the pinch-off tube on both sides.

TROUBLESHOOTING AND REPAIR

NOTE: Connect the hoses using care not to mistake the high pressure side for the low pressure side and vice versa.

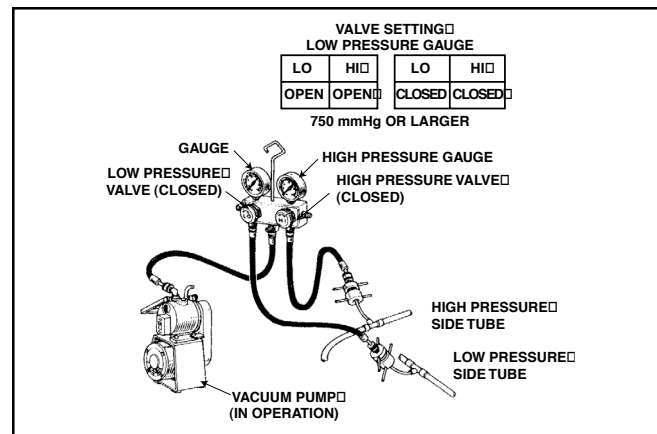
- (3) Connect the charging hoses (red - high pressure side, blue - low pressure side) of the gauge manifold to the process tube fittings.
- (4) Connect the charging hose (green) at the center of the gauge manifold to the vacuum pump.



Hose Connection

B. Evacuation

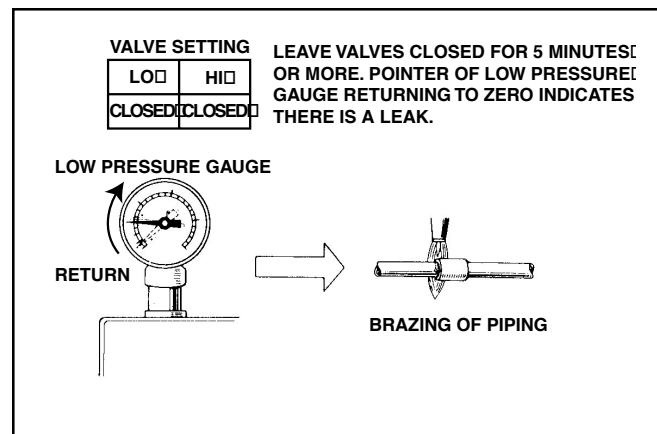
- (1) Open the high pressure valve (HI) and the low pressure valve (LO) of the gauge manifold.
- (2) Turn on the vacuum pump to start evacuation. (Evacuate the system for approximately 15 minutes.)
- (3) When the low pressure gauge indicates 750mmHg (29.55 in.Hg) or larger, turn off the vacuum pump and close the high and low pressure valves of the gauge manifold.



Evacuation

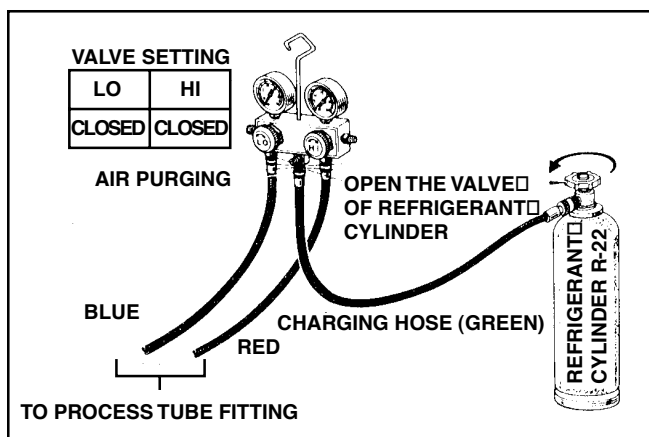
C. Checking Vacuum

- (1) Leave the high pressure valve and the low pressure valve of the gauge manifold closed for five minutes or more, and confirm that the gauge pointer does not return to zero.
- (2) If the gauge pointer returns gradually to zero there is a leak somewhere in the system (this could also include gauge manifold). Perform leak check according to procedure indicated in 24D. Once leak has been found and repaired evacuate the system once more, and confirm system holds vacuum.

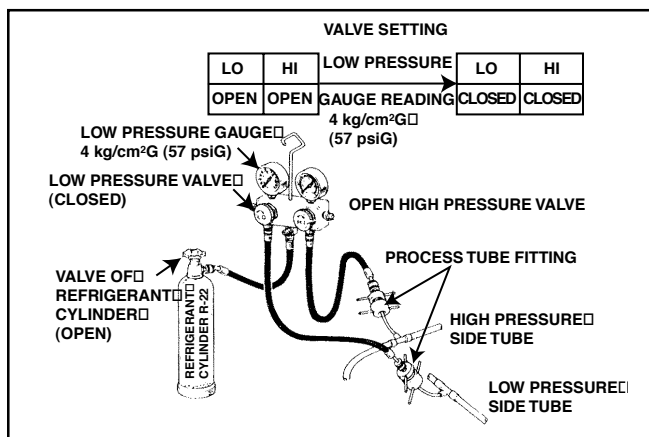


Checking Vacuum

TROUBLESHOOTING AND REPAIR

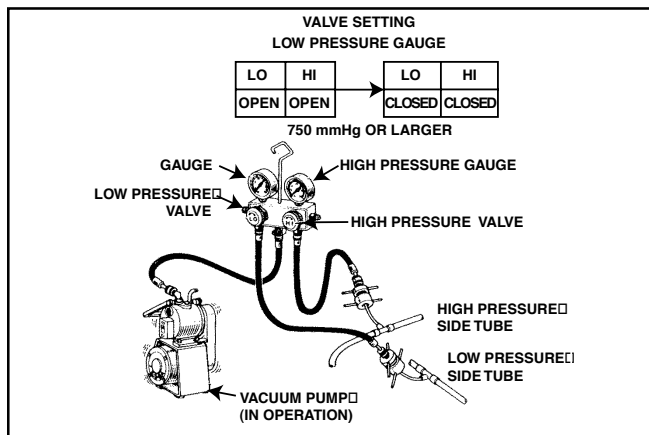


Checking Gas leak



Still Checking Gas Leak

⚠WARNING: Before checking for gas leaks, fully confirm that there is nothing flammable in the area to cause an explosion or fire. Contact of refrigerant with an open fire generates toxic gas.



Evacuation

D. Checking Gas Leak

- (1) Remove the charging hose (green) from the vacuum pump, and connect the hose to the refrigerant cylinder (R-22).
- (2) Loosen the nut on the gauge manifold side of the charging hose (green).
- (3) Open the high pressure valve of the gauge manifold. Charge the system with refrigerant until the low pressure gauge indicates 57 PSIG. (4 kg/cm²G.) After charging is complete, close the high pressure valve.
- (4) Check carefully for gas leaks inside the refrigerant system using the gas leak tester.
- (5) Repair any leak.

⚠WARNING: Do not attempt any repair on a charged system.

E. Evacuation (Repeat)

- (1) Close the valve of the refrigerant cylinder. Then remove the charging hose (green) from the refrigerant cylinder, and connect it to the refrigerant recovery machine.

NOTE: Keep the high pressure valve and the low pressure valve of the gauge manifold closed.

- (2) Using procedure 24B., evacuate the system until the low pressure gauge indicates 750mmHg (30in.HG) or greater. (For 15 minutes or more.)
- (3) After evacuation is complete, close the high and the low pressure valves of the gauge manifold.

⚠CAUTION: Be sure to evacuate the system twice or more using the repetitive vacuum method. Evacuate the system an additional time on rainy or humid days.

TROUBLESHOOTING AND REPAIR

25. Refrigerant Charging Work

A. Refrigerant Charging

- (1) Remove the charging hose (green) from the vacuum pump, and connect it to the refrigerant cylinder (R-22).
- (2) Loosen the nut on the gauge manifold side of the charging hose (green). Open the valve of the charging hose (green). Open the valve of the refrigerant cylinder.
- (3) Securely place the refrigerant cylinder on a scale with a weighing capacity of 70 lbs (30 kg) that is graduated by 0.2 oz (5 g).
- (4) Open the high pressure valve of the gauge manifold and the valve of the refrigerant cylinder. Charge the system with refrigerant to the specified amount.

Standard Amount of Refrigerant:
6.83 lbs / 3.1 kg

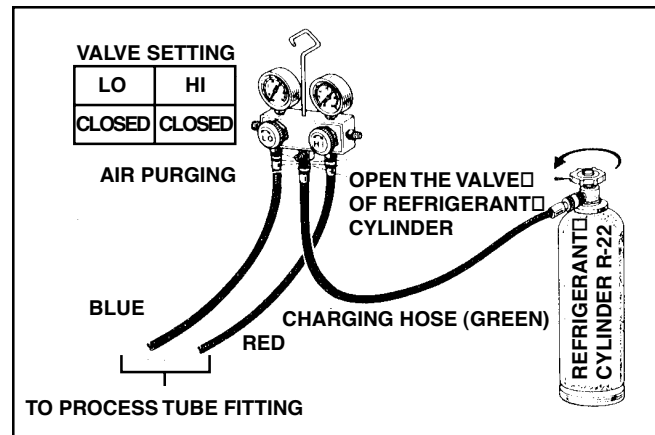
If the system cannot be charged with the specified amount of refrigerant under this condition, follow the steps below:

- (a) Close the high-pressure valve of manifold.
- (b) Operate the refrigerant system.
- (c) Slowly open the low-pressure valve while observing the scale reading.
- (d) When the scale reads the specified amount, immediately close the low-pressure valve.
- (e) Bring the system to a stop.

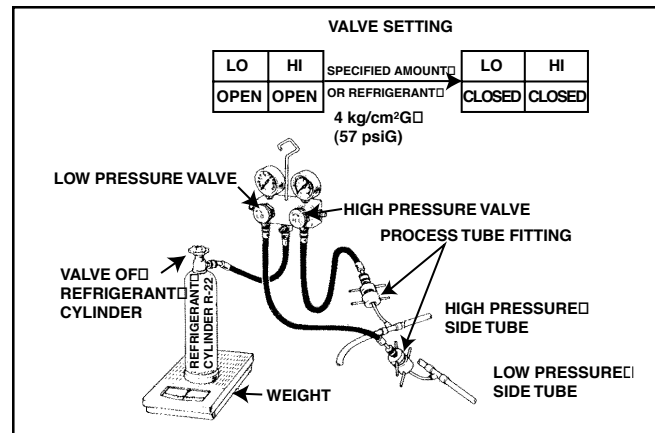
⚠CAUTION: The amount of refrigerant charged has a great effect on the cooling capacity of the unit. Charge to the specified amount, always observing the scale graduations while charging.

B. Removal of Gauge Manifold

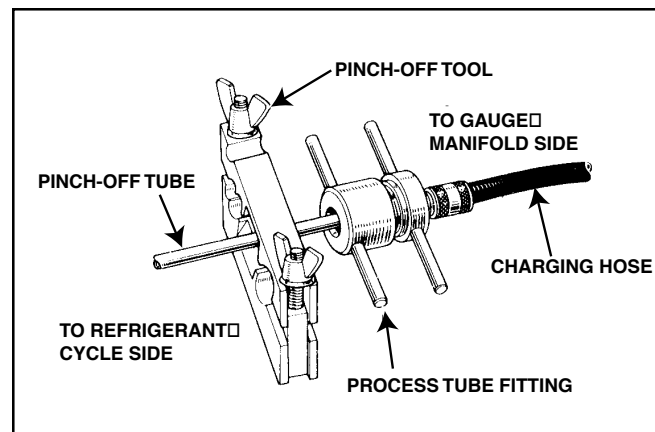
- (1) Crimp the pinch-off tube with a pinch-off tool.
- (2) Remove the gauge manifold and the process tube fitting. Crush the end of the pinch-off tube.
- (3) Braze the end of the pinch-off tube.
- (4) Ensure that a gas leak is not present at the pinched off portion and the brazed end.



Refrigerant Charging Work

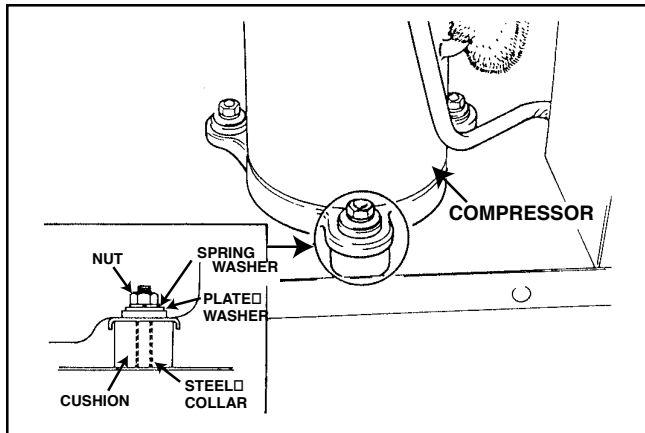


Refrigerant Charging Work



Removal of Gauge Manifold

TROUBLESHOOTING AND REPAIR

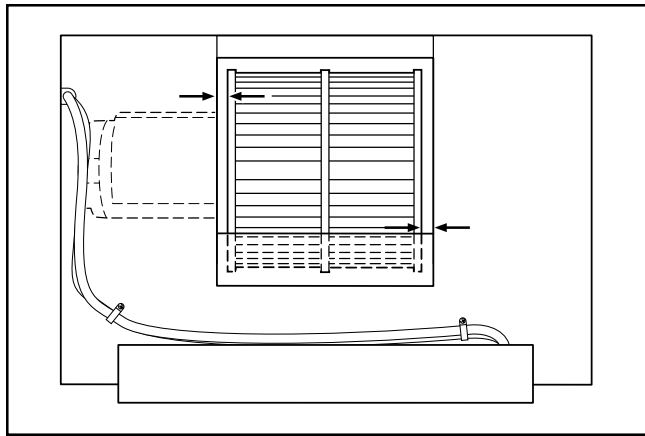


Compressor Mounting

Reassemble the unit in the reverse order of removal. Described below are the parts that require special care in reassembling the unit. Perform all wiring or rewiring as referenced in the wiring diagram.

26. Compressor Mounting

Mount the compressor on the frame, using cushions, steel collars, spring washers, plate washers and nuts.



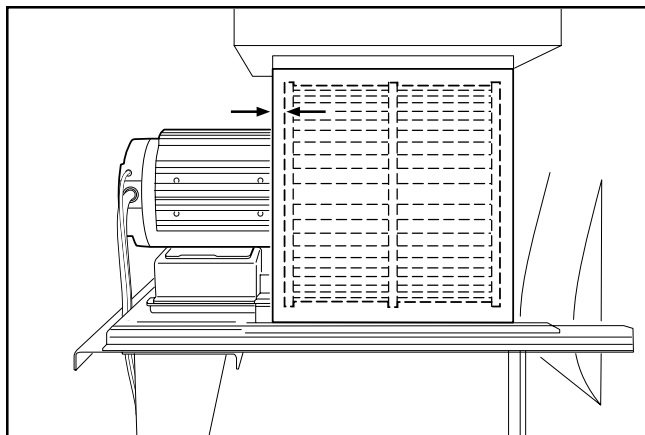
Evaporator Blower Assembly

27. Blower Assembly

- Install blower fan (for evaporator). Allow a clearance of 3mm (minimum) on each side of the evaporator fan.
- Install blower fan (for condenser). Allow a clearance of 3mm (minimum) on each side of the condenser fan.

Tightening torque:

$10.84 \pm 2.17 \text{ lbf}\cdot\text{ft}$ ($150 \pm 30 \text{ kgf}\cdot\text{cm}$)



Condenser Blower Assembly

28. Wiring Notice

Secure the wires using clamps so that they do not come into contact with the edges of the structure, etc. Secure the wires using clamps in the same position they were before removal.

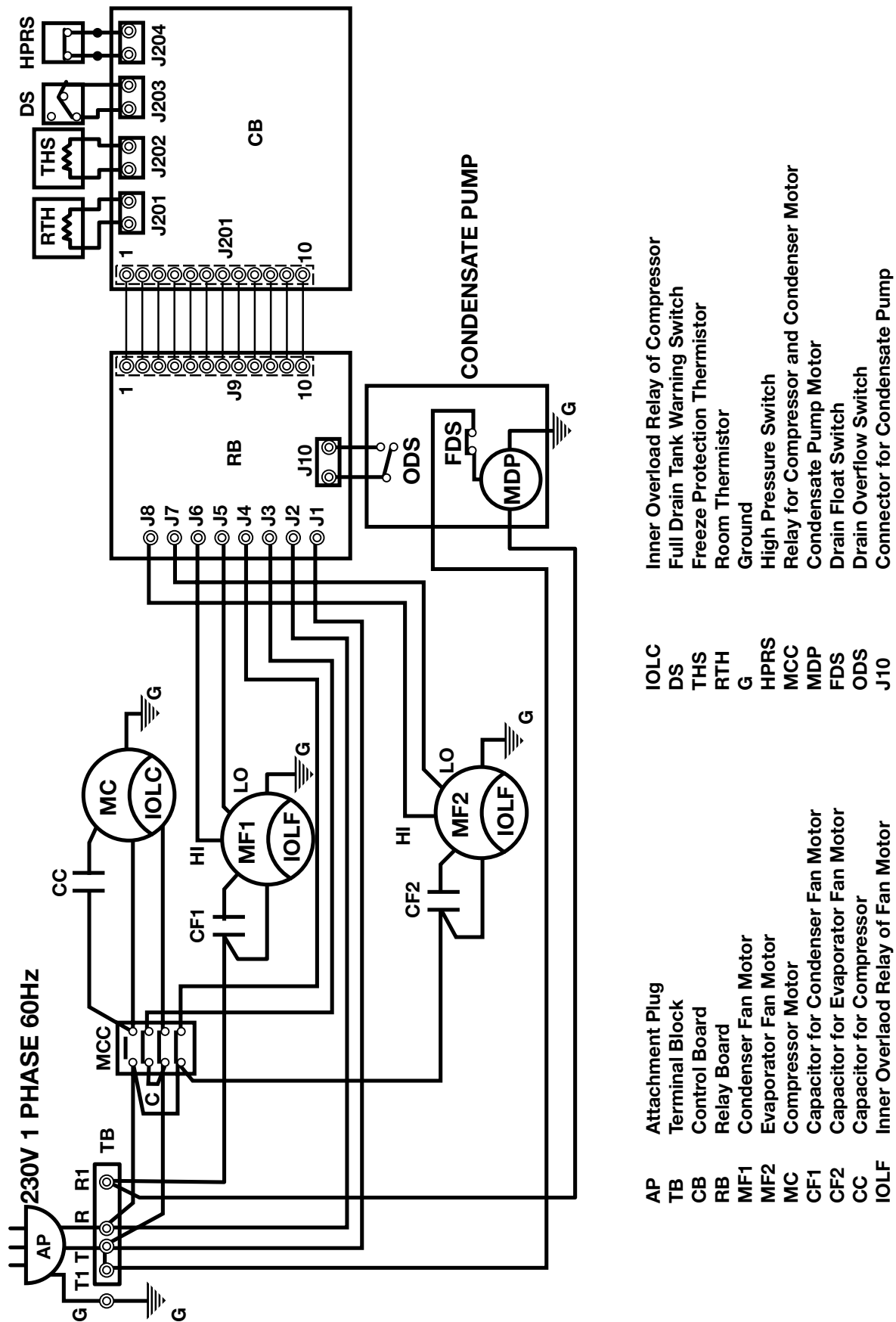
29. Perform the inspection of cooling capacity and check for abnormal noise or abnormal vibration.

30. Caster Maintenance

- Lubricate bearings in caster as needed with standard bearing grease using the zerk fitting.

NOTE: Casters should roll and swivel freely. Check for dirt or dust build up. Remove dust or dirt build up.

31. Schematic



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